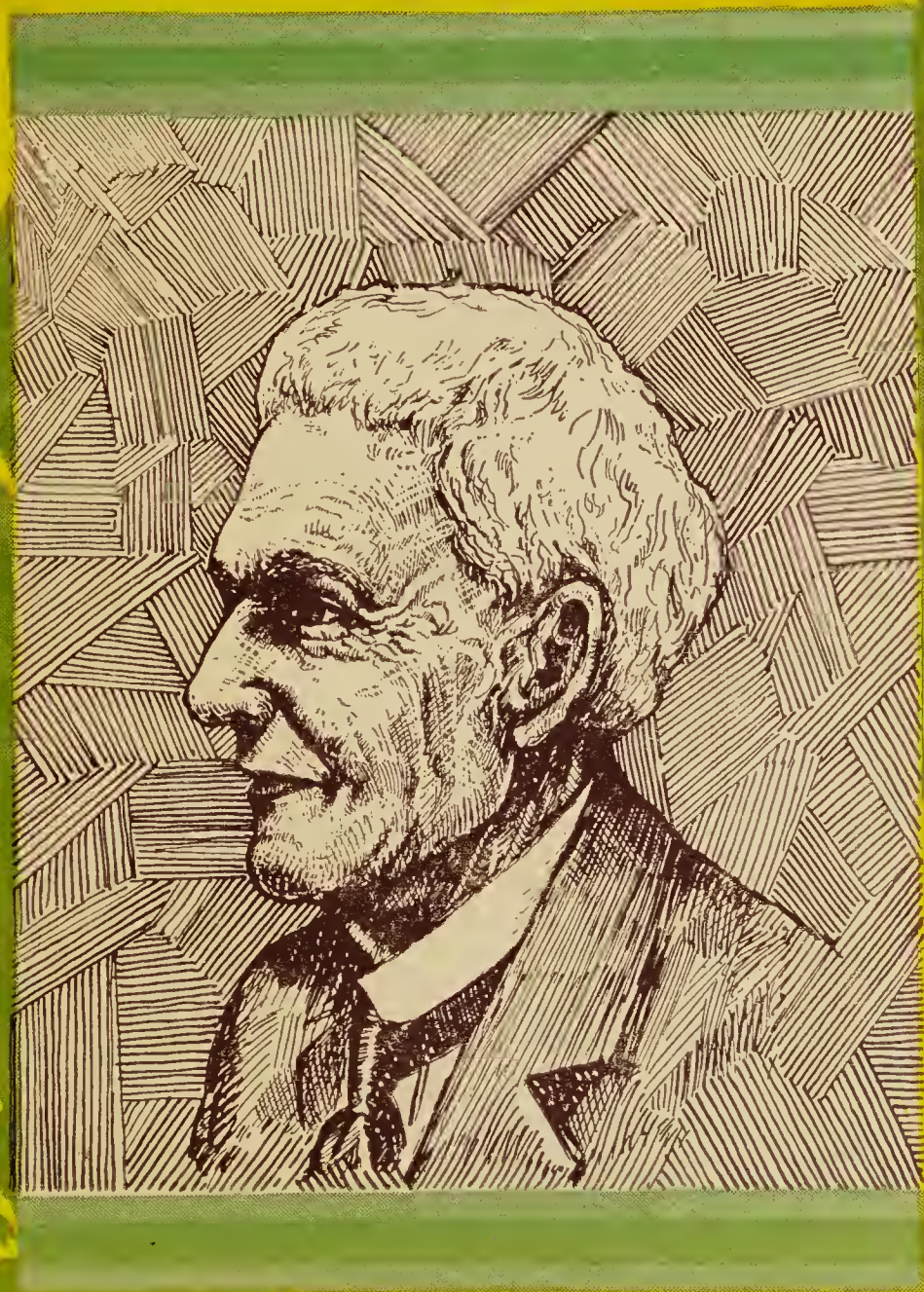


LUTHER BURBANK

PLANT MAGICIAN



By

JOHN Y. BEATY

Illustrations by Luis M. Henderson

LUTHER BURBANK

Plant Magician

By JOHN Y. BEATY

Author of NATURE IS STRANGER THAN FICTION, THE RIVER BOOK, SHARP EARS, etc.

Illustrated by LUIS M. HENDERSON

Luther Burbank has astonished the world with his achievements in the development of plant varieties. Giant fruits strangely flavored, trees of miraculously rapid growth—these, and hundreds more of economic and beneficial value, came from the wand of this magician of the earth. Thus, Burbank came to be a figure of myth and mystery in his own lifetime.

First-hand description reveals that Luther Burbank's methods were simple, matter-of-fact, and easy to follow. Working with millions of plants, with bees and hummingbirds for his chief helpers, Burbank opened a new frontier for Americans—one that can never be closed.

As a child on his father's New England farm, young Luther learned the first principles of plant life from the great naturalist Louis Agassiz. As a young man in the West resolved to make the desert blossom and find new things under the California sun, he planted a garden such as never grew before; and soon its products made their grower celebrated all over the world.

(see back flap)







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LUTHER BURBANK
PLANT MAGICIAN

To John Kieffer
Christmas - 1951
from "Mom and Dad"

LUTHER BURBANK

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By
JOHN Y. BEATY

Illustrations by Luis M. Henderson

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DEDICATED TO
MY MOTHER,
MRS. D. G. BEATY,

*Who first taught me to enjoy
this beautiful world which
Luther Burbank made still
more fascinating.*

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The Luther Burbank I Knew

We call Luther Burbank a plant magician because he performed feats with plants which were as startling as the illusions of the stage magician.

He made a red flower from a yellow one.

He made the stones of plums disappear.

He caused the desert cactus to grow a thousand times faster than it had ever grown before.

He made a blackberry white.

He made 500 kinds of cherries grow on one tree.

Luther Burbank was the first man to devote his entire time to creating new plants; and he succeeded in producing more useful new varieties of fruits, flowers, trees, vegetables, and vines than any other person. He demonstrated Nature's ability to provide mankind with new foods in almost endless variety, and he developed a method for helping Nature to create new plants more quickly.

He recognized time as a gift of the Creator which is to be used to the fullest extent; and he lived a happy life of seventy-seven years because he continually tried to be useful. His experience illustrates a way of working to

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make a dream come true which can be followed by any boy or girl with a goal in mind.

The boys and girls in Santa Rosa, California, where Luther Burbank lived, knew him as a friend. "Hello, Mr. Burbank," they would shout as they passed his garden. No matter how busy he was, he would stop, wave his hand, and call back.

I worked with Mr. Burbank in the preparation of books in which he told the story of his many plant experiments. My office was in his old home, where he spent at least an hour each day listening to me read the manuscript I had written. At other times, I went with him through his garden, or walked with him through his orchard. He would pick a plum, taste it, and if it pleased him, he would pick another one like it and hand it to me. He would tell me what he liked about the plum—or what was wrong.

One day I was walking with him through an acre of gladioli. Each plant in that acre was a new variety, and he was selecting those to be retained for future work. I always walked behind him, and did not speak to him until he stopped to rest and offered to talk.

On this day, he suddenly whirled around and with his extreme frankness said: "Say, I like you. You know enough to keep your mouth shut. Most people who come with me into my garden jabber, jabber, all the time, and

don't give me a chance to think. This is hard work I am doing. I am trying to decide whether to keep each flower or destroy it. And I can't be bothered with people asking me questions, until I stop to rest."

Because of the unpredictable things which Mr. Burbank accomplished, the newspapers of the country frequently published fantastic stories about his work. One story was that he had crossed the bee and the lightning bug so that the bee could work twenty-four hours a day! Another was that he had crossed the milkweed and the pumpkin vine, so that pumpkin pies were produced in the garden.

]

As a result of this publicity, he was sometimes irritated by the large numbers of visitors who came to see him from all parts of the United States, and other parts of the world. Some people came entirely out of curiosity, for his fame had traveled far and wide. Some liked to return home after a trip to say, "I saw the Great Burbank." If these people had nothing important to say to him, and if they had no intelligent questions to ask, he felt that talking with them was a serious loss of time.

After having been irritated by such visitors, he sometimes said: "Those people come here to look at me like an animal in a cage. I can't waste my time with them. My time is worth a hundred dollars a minute."

This does not mean that he was not friendly, or that he

LUTHER BURBANK

was discourteous. He sometimes spent two hours with one person—\$12,000 worth of time, at his own estimated value—simply because that person asked intelligent questions and proved to be an intelligent listener.

While there were times when certain work had to be attended to without delay, it was seldom that Mr. Burbank was too busy to see a visitor who was genuinely interested in plant development. He was always willing to share his knowledge and experience; all during his life, Mr. Burbank encouraged scientists, nurserymen, seedsmen, and agricultural authorities to visit his grounds and comment on what they saw. He was always free to tell what his objective was and always free to explain how the progress observed had been obtained. He had no secrets. He enjoyed talking with anyone who understood his work.

On one occasion, he had the pleasure of entertaining Thomas Edison and Henry Ford at the same time. The three men were very much alike in that they all had the ambition to serve mankind. And they all realized that the way to do it was to study earnestly, plan systematically, and give the utmost attention to details.

They enjoyed each other's company because of the similarity in their natures. Mr. Edison considered Mr. Burbank an inventor, and Mr. Ford was particularly fascinated with the mass production technique Mr. Burbank

carried out with plants, and which was so similar in principle to the mass production in Mr. Ford's automobile plants.

By the time he was sixty-three years old, Luther Burbank had created and introduced for man's use, two hundred and twenty new varieties of trees, vegetables, fruits and flowers.

He started to work with the potato, sweet corn, daisy, and bean in 1872. He started with black walnuts in 1874. He experimented with the gooseberry, blackberry, raspberry, Juneberry, strawberry, and currant in 1878. Prunes were added in 1879.

In 1884, in addition to continuing work with the previously named plants, he added the pear, quince, peach, chestnut, loquat and the persimmon. He began work in earnest with plums, grapes, and the verbenas in 1885. In 1886, he added work with apples and almonds. In 1887, tomato experiments were begun.

We might go on and on, naming additional plants which were added to his garden each year, but we would have to emphasize that the plants previously mentioned were still growing by the thousands. His interest in them was perpetual. It would be very difficult to mention any plant which did not have his attention at some time.

He created seventy-three new flowers. He introduced sixty-six new kinds of fruits which grow on trees, and

LUTHER BURBANK

twelve new fruits which grow on bushes. He produced nine new vegetables; one new grape; one new ground nut; seven new tree nuts; and thirty-five varieties of a new kind of cactus for feeding livestock.

It is impossible to compile a complete list of all the new varieties of plants Luther Burbank created. Many of them were sold to seedsmen and nurserymen who gave them new names without any reference to their originator. Some of them, such as the *Shasta* daisy, have become so common that no reference is made in many seed catalogs to the fact that they were originated by Luther Burbank. And many seedsmen list several varieties of the *Shasta* daisy.

However, the list at the end of this book of two hundred and thirty-four new varieties, representing more than forty-six different kinds of plants, will illustrate the wide variety of work he did.

Among the most interesting of the new plants produced by this plant magician, were: The white blackberry; a spineless cactus which produces more food for livestock in one year than any other plant; plums larger than any before known to man; cherries that are ready to eat in February; a white daisy larger and more beautiful than any Nature had produced without his help; a plum without a seed; and a delicious blackberry whose stems had no prickles whatever.

THE LUTHER BURBANK I KNEW

Most people think that only a plant magician could induce Nature to make such drastic changes, but, just as the tricks performed by the magician on the stage are really very simple in operation, so the methods used by Luther Burbank to perform his plant magic are simple. They are methods which can be used by anyone who would like to help Nature create new and interesting plants.

JOHN Y. BEATY.

LUTHER BURBANK
PLANT MAGICIAN

1. A BOY ASKS "WHY?"



LUTHER WAS LYING ON A BIG FLAT stone, his bare feet partly covered by the water in the pond. He was watching a snail feeding on a water plant.

Moving slowly but steadily, the snail crawled to a leaf of the plant just below the surface. Then, still watching, Luther blinked and rubbed his eyes because he could not believe what he saw. The snail was walking upside down on the under surface of the very thin film that covered the water!

Because Luther could not see the film, it seemed as though the snail were walking on nothing. Then he began to realize that the snail did have something to walk on, after all. He had heard some of the men who visited

his father tell of the film which covers the surface of all water, but it had never seemed to him that this film could be strong enough to hold up a weight like that of the large snail.

Luther could see the snail's eyes at the base of two long feelers. When one of these feelers touched another plant, the snail stopped and explored, moving the feelers this way and that. Then it walked down the leaf of the new plant.

While the snail was walking upside down on the under surface of the water film, Luther could see its mouth opening and closing as though it hoped to find another plant leaf it could chew. He could see the way its one foot operated. While a snail seems to move very slowly, the parts of the single foot can be seen to move rather rapidly as it glides just below the water surface.

The snail started to eat the leaf of the new plant on which it had found a resting place. Luther watched it for a while longer, until his attention was attracted by another animal—one he had not seen before. It was crawling slowly up the stem of a cattail plant. It was light brown in color, and about two inches long. It had six legs. Slowly, the animal crawled, and when it was about eight inches above the water, it stopped and remained very still.

Luther watched it until he heard the farm bell which his mother rang to call the family to lunch. He returned

in the afternoon and then noticed that the shell of the animal was beginning to crack along the back. What in the world could be happening to this insect? He had concluded that it was an insect, because only insects have six legs.

As the crack grew larger, Luther could see that there was a soft skin inside. And he could see that this animal's inside body was pushing against the outside shell, thus making the opening wider and wider.

After several minutes, the upper portion of the animal was pulled from the shell, and then Luther could see that it was the body of a dragonfly.

At length, the tail portion came out of the shell. Then the wings slowly unfolded, for they had been tightly pressed against the back. As the wings unfolded, they were stretched out at the sides, and finally, they became rigid. Luther was so fascinated by this strange transformation that he forgot about the time and was late for supper.

At home, he told his father what he had seen.

"Yes," said his father, "you have seen a dragonfly break through its skeleton and enter into adult life."

"But why does a dragonfly live in the water?" asked Luther.

"The greater part of a dragonfly's life is spent on the bottom of a pond or stream," his father explained. "It

doesn't look like a dragonfly then. It looks like the animal you saw crawl up the stem. In that stage of its life we call it a nymph.

"The mother dragonfly lays her eggs in the water. When the babies are hatched out of the eggs, they go to the bottom where they find their food. The dragonfly nymph eats all sorts of tiny living animals, great quantities of them. In fact, it will eat another nymph if it can find one."

"Does it swim?" asked Luther.

"No. While it is in the water, it is able to move about by using its legs. It also squirts water from the rear end of its body to force itself quickly here and there. But after it is transformed into a full-grown dragonfly and lives above the water, it can move about only by flying. It has six legs, but it can't use them for walking. The legs are so placed as to make a basket or trap with which it can catch mosquitoes and other flying insects as it darts through the air."

"Why does it catch insects?" asked Luther.

"While it flies, it holds this basket near to its mouth and eats what it has caught," said his father. "When it alights on a plant stem, it does not walk. It must take off from the same spot on which it landed. Its legs are made for catching food. They are not made for walking."

During the many trips Luther made to the pond, he

observed tadpoles, minnows, turtles, frogs, crayfish, red-winged blackbirds, herons, and that strange animal, the leech. One day he found a large leech—about two inches long—attached to the neck of a turtle. It was fat because it had just enjoyed a full meal of turtle blood.

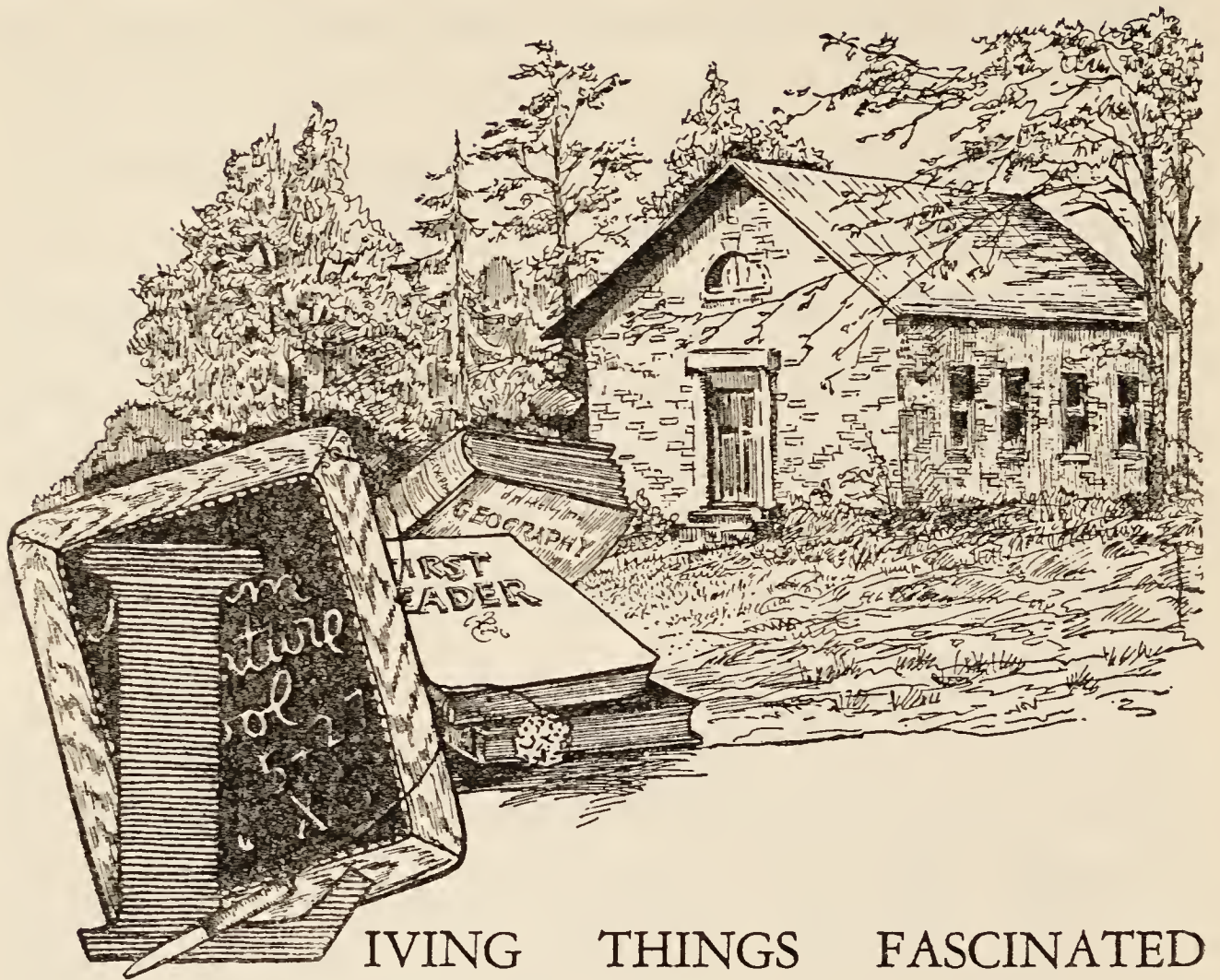
Luther took it home and placed it in a jar of water by itself. For several months, he kept it this way without food. It is true that the leech was then smaller than when he put it into the jar, but nevertheless it was still alive. By this experiment, he learned that a leech may live as long as a year on one meal.

Leeches are sometimes called ‘‘bloodsuckers.’’ And indeed, that is a good name, because they suck the blood of animals. They do it in such a way that the victim does not realize that they are stealing the blood the animal itself needs.

The leech has sharp teeth with which it punctures the skin and the blood vessels. But it instantly injects a fluid which affects the nerves in such a way that they do not send a message of pain to the brain of the animal. In other words, the leech can suck blood from an animal without causing any pain at all.

Luther might have learned these things about water plants and snails, dragonflies and leeches, by reading after he was older. But he always remembered what he saw for himself in the pond, and what his father said in answer to his questions.

2. WHAT FARM LIFE TAUGHT



IVING THINGS FASCINATED young Luther Burbank and he spent most of his time learning about the plants and animals which help to make this world a beautiful place. As if to prepare him for the important use he was to make of the heredity and environment of plant life, his early environment and his family helped him to grow up with a knowledge of the country.

Luther Burbank was born March 7, 1849, on a farm near Lancaster, Massachusetts. As a baby, he must have looked out on the lawn and elm trees blanketed with the snow of the long New England winter. But inside the big red brick farmhouse, heated by log fires, it was warm

enough for babies and house plants to be comfortable. Luther's mother was fond of flowers and she found she could keep the baby happy and quiet by giving him a flower to hold in his own hand. Turning the blossom in his tiny fingers, he would look at it seriously, curiously, and forget to cry.

As the baby grew, the world changed; his father, Samuel Walton Burbank, owned many acres covered with trees which were cut for lumber. He also owned a clay pit from which he took clay for making pottery and brick. So there was always some interesting activity to take a growing child outside the house. Most important of all, there was a meadow, a stream, and a marsh in which all sorts of living things attracted the attention of the boy as he grew older.

Luther started school at the usual age and, although he was eager to learn, school was somewhat of a trial, because he was a very timid child. It was the custom for each scholar to stand before the entire school to recite. That was most difficult for Luther. After the teacher realized his timidity and allowed him to write his lessons, he got along much better.

His school was conducted in a little one-room red brick building in the woods. It was held every day of the week, except Sunday. However, every other Saturday afternoon was a half-holiday. This half-holiday was necessary to

allow the children's mothers to wash their clothes. It was customary for each child to have only one suit of underwear, and the children had to go to bed while their underwear was washed.

Sunday was a quiet day because, according to custom at that time, even a walk in the woods was not advisable on the Sabbath. However, Luther's parents, realizing how much he loved the wild things, were not very strict on this point.

Although Luther was very fond of the out-of-doors, much of his time was spent in making things. He made windmills and waterwheels. He made statuary and ornamental pottery from the clay in his father's pit.

Luther's mother, Olive Ross Burbank, was his father's third wife and she had two children before Luther, but both of them died in infancy. Luther was the oldest of his mother's family when his mother later had two other children, a boy and a girl. His father's older children had all gone away from home to work by the time Luther was ten years old. So it was natural that he should feel considerable responsibility for helping his mother in caring for his brother and sister. He also spent much time in helping her with her flowers and vegetables.

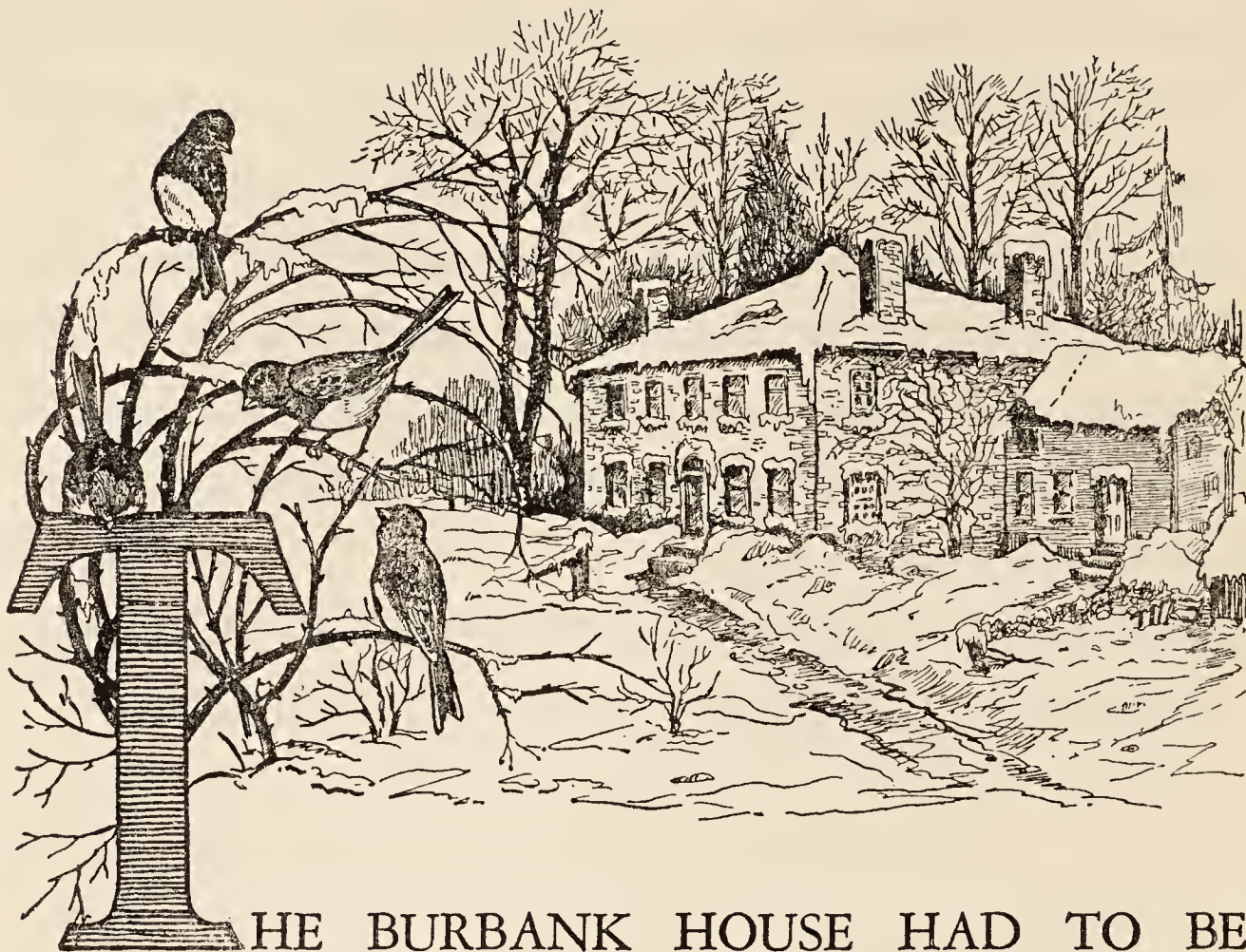
Even before he was ten years old, Luther realized that this is a beautiful and a wonderful world and he wanted to know more about it. He wanted to know why some

WHAT FARM LIFE TAUGHT

plants grow under the water, while others grow only above the ground; why some trees have broad leaves and others have leaves as narrow as needles. He tried to guess how new plants were produced and old ones persuaded to change their habits of growth. He wondered whether it would be possible to improve or hasten the processes of Nature—for example, to make plants grow faster so that his mother might have flowers and vegetables earlier in the spring.

Eventually, he was to find answers to all these questions, and to make practical use of the information.

3. A GREAT MAN GIVES A CLUE



THE BURBANK HOUSE HAD TO BE large enough to hold, not only the large family of children (Luther was his father's thirteenth child) but the ministers, teachers and lecturers whom his father enjoyed entertaining. Some of the world's greatest scientists came to Lancaster while Luther was a boy, and stayed as visitors on the Burbank farm.

Although Luther knew that these important men would be talking about something that he wanted to learn, he was so timid that he did not enjoy meeting the strangers. But he did want to hear what they had to say, so he often sat on the ground outside an open window to hear his father ask questions, and the visitors answer them. Every

A GREAT MAN GIVES A CLUE

fact thus discovered was a treasure to him, because he had very few books to read. As a matter of fact, very few of the answers to his questions were to be found in books at that time.

As he grew older, he became less timid and he then asked questions himself. In that way, he was able to learn more and more.

Professor Levi Sumner Burbank, his father's brother, often lived at Luther's home for several weeks at a time. He was in charge of the department of geology in the Museum of the Boston Society of Natural History, and he made many long trips with the famous scientist, Louis Agassiz. Luther was very fond of his Uncle Levi, who was willing to take his young nephew into the fields and woods and tell him interesting things about Nature.

With his uncle's help, Luther learned that he could understand many of Nature's secrets if he studied the flowers, trees, insects, and larger animals for himself. Often, instead of playing games with other children, he walked through the woods and into nearby fields to see what the interesting living things were doing. He saw the flowers thrust up their first leaves in the spring. He saw the frail petals of the blossoms appear. He watched the bees as they carried pollen from one flower to another. Then he saw the flower petals fall, and the seed pods develop.

In this way, he early learned that many flowers live their complete lives in one short season. The seed germinates in the spring; the plant dies in the fall. But he observed that other plants, like the trees, live much longer lives. Some of them live longer lives than men.

Some plants, he also discovered, live very strange lives and do queer and unexpected things.

Luther had noticed a certain kind of plant in the pond which grew entirely below the surface of the water. None of it came above. It had very fine leaves, and Luther thought that he saw little bags on the stems here and there.

One morning, while he was lying on the flat stone looking for something new, the sun shone on the water in such a way as to light up the place where there were several of these little bags. Luther saw some tiny animals swim into one of the bags. He waited to see them come out again, but they did not reappear. A little later, he saw others swim in. None came out.

Then he looked at several of the other bags. Occasionally he saw little animals swim into them, but never did he see any come out.

"What in the world can happen to those little animals?" he asked himself.

That evening, in the living room at home, he told

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Professor Levi Burbank what he had seen. The professor was greatly interested.

"Where was the plant?" he asked.

"I saw it in the pond," said Luther. "While I was lying on the stone, I saw tiny animals swim into little bags which grow on the stem of this plant. Dozens and dozens of little specks swam into the bag, but none ever came out. Why was that?"

"That was because the plant ate them," explained Levi Burbank.

"But, Uncle Levi, how can a plant eat animals?" asked Luther.

"The plants you saw," said the scientist, "do not get all of the elements they need out of the food in the water. There are certain things in the bodies of animals which these plants must have. So, they are provided with traps in which to capture food. But how did you happen to see the little animals caught by the bladderwort plant?"

"Is that what the plant is called?" asked Luther.

"Yes," said the teacher, "the traps are called bladders."

"Well," Luther explained, "the sun was shining on the water in such a way that I could see very clearly. I saw little specks moving near the plant, and as I watched, some of them went into the bladders. I didn't know what was happening. I didn't know the plant was going to eat them."

"Besides the bladderwort, several other plants eat animals," said the professor. "Most of them grow in swamps and bogs. Several of these plants are called 'pitcher plants' because some of their leaves are made into pitchers. Insects crawl in from the top. After they get inside, they cannot get out. These plants grow above the ground, but their roots are in wet soil. Pitcher plants eat insects just as the bladderwort eats tiny animals.

"There is another plant," continued the scientist, "which we call the 'sundew.' It has some stems which have a round disc on the end, from which project tiny arms. On the end of each arm is a sticky substance. If an insect alights on one of these discs, the disc quickly folds its arms toward the center. These arms come together so that the insect cannot get out."

"Well," said Luther, "I knew that animals eat plants, but I did not know before that some plants eat animals. Every living thing seems to depend upon something else, doesn't it?"

"You are right, Luther," said the scientist. "Some plants help animals; other plants help plants; some animals help plants; and some animals help other animals. But at the same time, there are some animals which prey upon other animals, and some plants which prey upon other plants. There are plants, for example, which get all of their living from others. We call them 'parasites.' They

A GREAT MAN GIVES A CLUE

cannot digest their own food, so they live on other plants and take food which the hosts compound in their leaves."

PLANTS THAT DRINK A STREAM DRY

Near the pond was a small stream, full of water in the spring; but usually, by the first of July, the water was gone. Luther wandered along this little stream, and even after the first of July, he found some water in the upper part; but farther down, where the cattails filled the bed, there was no water. Luther had often wondered what caused this. Now that he had a chance to talk with a scientist, he asked why there was no water in the lower part of the stream.

"The cattails drink all the water," explained Professor Burbank.

"Oh, but, Uncle Levi," objected Luther, "I don't think the cattails could drink so much. There is really quite a lot of water in the upper part of the stream."

"You would be surprised to know how much water cattails can drink," said the scientist. "Cattails often drink a stream dry."

"Just how does a plant drink?" Luther wanted to know.

The professor then explained that a plant takes water out of the soil with its roots. Water goes to the leaves and some of it is used there in the making of food, but most of it passes on into the air. The cattails, when they drink

a lot of water, as they do when there is plenty of water in the stream, give off great quantities of it into the air. As a matter of fact, all land plants give off water into the air, but cattail plants evaporate more than many others. It has been learned, for example, that an acre of grass can give off as much as six tons of water in one day!

"Well," mused the boy, after listening to his uncle, "every plant seems to have something about it that is very strange. I want to know more about plants."

Luther wanted to learn more in order to do more; he had discovered that those who understood the ways of plants could indeed work with Nature to change long-established habits of growth. When he was only fourteen years old, his Uncle Levi taught him how to cut a small branch from one tree and graft it on another. In this way, he was able to make pears grow on an apple tree, and apples grow on a pear tree.

Luther's most important lesson was learned from the great scientist, Louis Agassiz, of Harvard University at Cambridge, Massachusetts. Luther did not go to Cambridge; the great man came with Professor Levi Burbank on one of his visits to the farm.

While Dr. Agassiz was visiting with his father, Luther managed to ask several questions about the way new plants are made. Dr. Agassiz explained that, before a seed can be formed, the pollen of one plant must be

brought by the wind, by the water, by a bird, by an insect, or by man, and some of it must become attached to the little finger called the "pistil," which is usually found in the center of the flower.

The end of the pistil is sticky. When the pollen adheres to this, it develops into a pollen tube which grows down through the stem of the pistil and into the ovule. There the sperms in the pollen join with the tiny female cells which then grow into seeds.

"Seeds, however, are never made," explained Professor Agassiz, "unless pollen is brought to the pistil. If the pollen comes from a flower of a different variety, the seeds will grow into new plants which may be better, or may be much less useful, than the plant on which the seeds grew. However, the two plants supplying pollen and pistil must be related; they must belong to the same species or genus."

"Then," said Luther, "the way we get new varieties is to take the pollen of one plant and put it on the flower of another?"

"Exactly," agreed the great scientist. "When we do this, we help Nature bring about improvements. That is, we do if we destroy all new plants which are of less value than those we already have.

"For example, you might produce a thousand seeds by crossing the pollen of one plant with another, and only

one of the thousand might grow into a plant which was better than the plants we already have. If you allowed the other nine hundred and ninety-nine to continue to grow, the world of plant life would become less useful, rather than more useful. Nature has ways of destroying these less useful plants, but man can greatly help her."

"By killing weeds," suggested Luther, having in mind his own experience in his mother's garden.

But here Dr. Agassiz made another important observation. "We often call weeds pests when there are too many of one kind. When great quantities of them interfere with crops, we destroy them; but so-called weeds may be developed into valuable plants."

Perhaps Luther did not realize it then, but in this short lesson given him by a famous naturalist, he had the basis for his future life work. Dr. Agassiz had told him how to be a plant magician.

In the days that followed, Luther made long trips into the field to study plants. One day, while he was examining the blossoms in a field of black-eyed Susans, he saw that each flower was slightly different from all of the others. One had a petal that was shorter than all the rest. One blossom was a little larger than the others.

While all of them appeared to be yellow, Luther found several to be a darker color—almost red. He also

found one blossom which was much lighter in color. It could not be called white, but it certainly was a light yellow.

As Luther was examining these black-eyed Susans, he said to himself, "I wonder if there really are any two things in this world which are exactly alike."

He went through the bed of black-eyed Susans again with this thought in mind. When he found two which at first seemed to be similar, he compared them very carefully and saw that the petals of one were a little longer than the petals of the other. The black eye in the center of one was slightly larger than the eye of the other. There were differences—important differences.

"If it is true," said Luther to himself, "that there are no two things in this world alike, then it ought to be easy to make new kinds of plants. Professor Agassiz says that all you have to do is to carry the pollen from one flower to another of a related kind. Then, the seeds will each produce a new variety.

"Well," decided Luther, "I'm going to test that idea right now. I shall carry the pollen from the largest flower to another that is as near perfection in shape as I can find, and see what happens next spring when I plant the seeds which result from that crossing of pollen."

He selected the largest blossom in the field, broke off the flower, and carried it to another blossom which he

liked because of its more even shape. All the petals of the second flower seemed to be of the same length.

When he tried to transfer the pollen, he learned that there was no pollen. He examined many other blossoms, and finally discovered that the pollen is on the flower only when it first opens. It is necessary to transfer the pollen just as soon as possible after the blossom has begun to spread its petals.

He also discovered that the black head in the center of a black-eyed Susan is made of many tiny flowers. One flower is a tiny tube in the center of which is the pistil and the stamens, and there are many of these tiny tubes in one flower head. Professor Burbank explained to him later that the black-eyed Susan is called a "composite" flower because the petals surround a great many sets of pistils and stamens instead of one set. The composite has many flowers surrounded by one group of petals.

As he studied the blossoms in the fields day after day, Luther began to realize that he could control conditions better if he had some of these plants in his garden. At the time this thought came to him, he was walking through a field of oxeye daisies. He selected two plants which he thought he would like to work with, and, having no tool but his pocketknife with him, he spent half an hour carefully digging these plants out of the ground.

He took them home and planted them in a sunny place in his garden. There he watched over them carefully. When his father saw them, he said, "Luther, I wish you would dig those weeds out of the garden and destroy them."

"Oh, but father," pleaded Luther, "I planted them there."

"You—you planted them!" sputtered his father, amazed. "Why did you plant weeds in our garden? It is hard enough to get out those which start by themselves."

"I want to try to produce some new varieties," said Luther.

"New varieties of weeds?" asked his father. "Don't we have enough weeds as it is? The poor farmers complain bitterly because there are too many weeds here now."

"Perhaps," said Luther, "we can make a flower that will be better than the weed. I'll promise that if you will let me keep these oxeye daisies in the garden, I will not allow them to become weeds here."

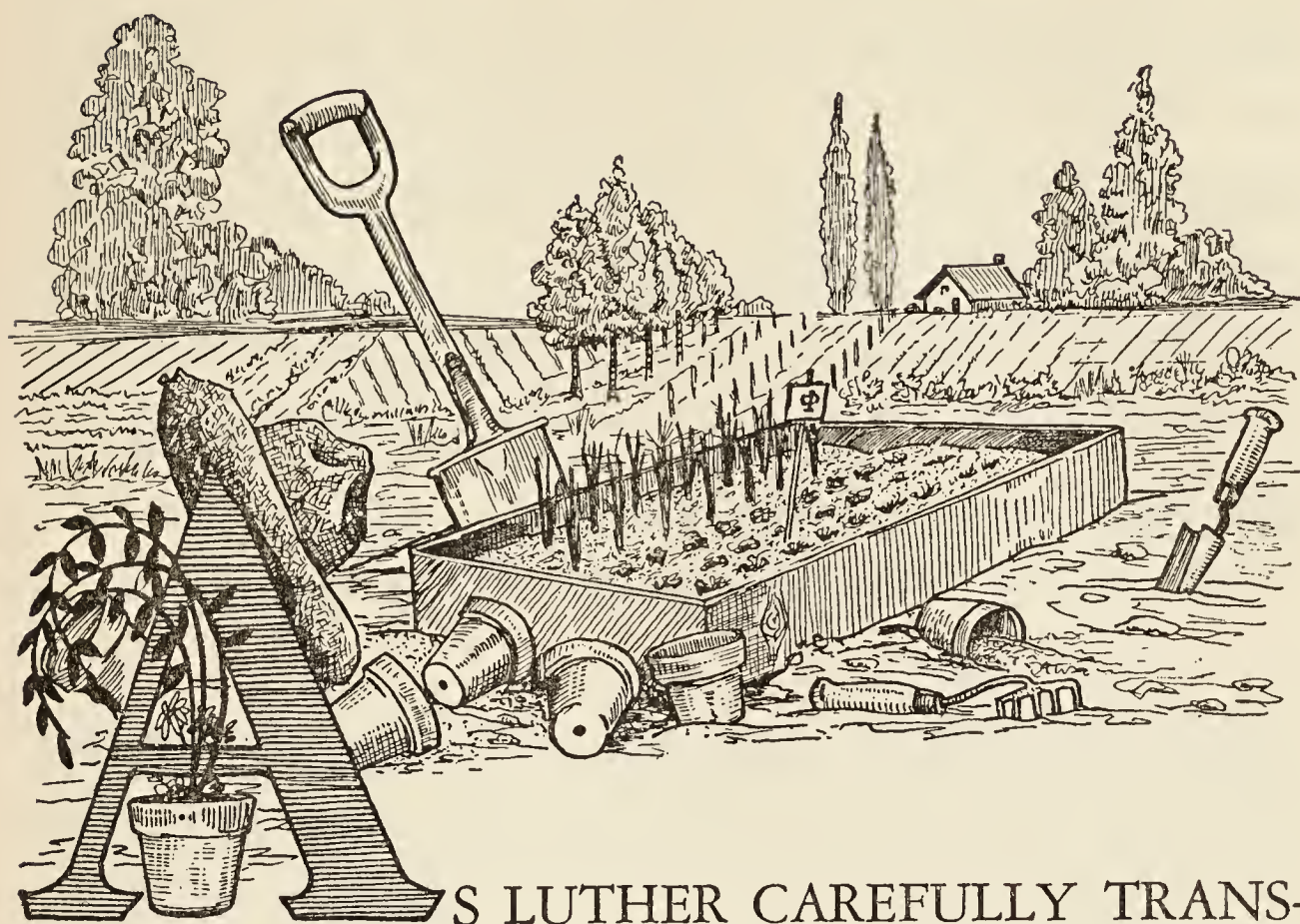
"Well," his father conceded, "you may do that. It will be a good way for you to learn some of the things you need to know about plants."

While the oxeye daisy was a troublesome weed to the farmers near Lancaster, Massachusetts, it was a prized

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possession of the young Luther Burbank. He did not know then how important it would be to his future life. But it turned out to be one of the most valuable flowers with which he experimented. With its help, he later astonished the world.

4. EXPERIMENTS WITH WEEDS



AS LUTHER CAREFULLY TRANS-ferred the pollen of the two daisy plants he had brought from the field, he hoped that he might harvest seeds to produce new varieties. He took the pollen from one plant and put it on the flowers of the first one. In that way, he crossed the pollen both ways.

He waited eagerly for the seeds. When they ripened, he collected them carefully. He planted them the next year with high hopes.

By this time, he had interested his mother in what he was doing, and she encouraged him in his experiments. He watched the bed in which the seeds were planted and learned many new principles of plant life.

As soon as the new daisies began to show above the soil,

he saw that each one was different. Some grew faster than others; some were a darker green than others. Some stems were covered with fine hairs; others were more nearly smooth. Try as hard as he would, he could not find two plants which were exactly alike.

At first, this disturbed him. "If everything is different," he asked himself, "how can I multiply a new flower if I find a new variety I want to keep?"

Later he was to learn the answer to that question.

When the blossoms came, they proved that the crossing of flowers by exchanging pollen does produce a great variety of new plants. But none of the blossoms was really beautiful. Most of them were very tiny; they were all disappointing.

Luther talked with his mother about the discouraging results of his experiment.

"I want a daisy," he explained, "which is whiter and which has a blossom very much larger than any I have ever seen. Not one of these new plants in this plot is worth keeping."

"Perhaps you shouldn't expect something better from this small number," his mother suggested. "It may be that there is only one better flower in many, many thousands. It is possible that you may work an entire lifetime to produce just the type of flower you want. But some of these

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plants may help you in future crosses. Why don't you hunt for a better flower in the field and bring its pollen here to put on some of these?"

Luther followed his mother's suggestion, but the results the following year were just as disappointing as those of the first. Then Luther admitted to his father that his effort had not brought the hoped-for results.

"What are you going to do with those new weeds you have created?" asked his father.

"I am going to pull them out and burn them," said Luther, sorrowfully. "Dr. Agassiz said that new plants which are less useful than the ones we have should be destroyed. And these are worse than the daisies in the field. They are all new varieties, but none of them is any good."

"That is a splendid idea," said his mother. "When you have something you are sure is valueless, it is best to waste no more time with it."

Luther did not realize it, but that statement of his mother's was to be important in his future work. All his life, he made it his practice to burn those plants which were valueless, just as soon as he was sure that they would not be useful to him in further tests.

Luther burned the weeds as he had promised, but, as he stood watching the fire, he continued to have visions of the daisy he would like to produce.

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"It must be very large," he repeated to himself, "and it must be very white. A white daisy with a yellow center against a green background of foliage would be the most beautiful flower in the world. I know now that I can produce new varieties. I shall keep on trying until I get the new flower I want."

Luther's early experiments were not confined to the daisy. He collected some of the New England asters which had purple flowers, carried the pollen from one to the other and raised plants from the seeds. He carried on so many experiments that his father complained that he had turned the vegetable garden into a field of weeds.

Luther's mother, however, explained to his father that the boy was learning some important lessons, and the little amount of ground he used was no loss, because Luther was taking good care of the vegetable garden, and the family had plenty of vegetables to eat.

Luther's experiment with the asters further showed that he could get new varieties. Some of the blossoms were of entirely new colors, others had petals which were twisted and curled. The foliage of some was striped. There were all sorts of variations.

However, none of them was better than the wild asters which had been produced and perpetuated by Nature herself. Luther burned the results of these experiments, saving some of the seeds for further tests.

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One day, Luther's father read a letter from one of his two sons who had gone to California. In the letter, Luther's brother said that the climate in California is such that plants grow the year around.

"That is where I want to go," Luther announced. "It takes so long here to get a new plant from seed. A seed that is produced one year cannot be grown until the next. If I were in California, I could plant the seed which I grow this spring as soon as it is ripe, and I could see my new plant in just a short time."

"But California is a long way from here," objected his father. "It would cost a lot of money to get there. It would take several days on the train."

"Then," announced Luther firmly, "I shall save my money until I get enough to go."

His father and mother were talking over Luther's ambition that evening, and his mother asked, "Do you think that Luther will really save enough money to go to California?"

"Don't worry," commented his father. "It will take him so long that many things may happen in the meantime. He will perhaps have other ideas which will take the place of those he had today. I don't believe that there is any chance of his going to California."

But Luther was sure that what he wanted most was to go where he could grow more plants in a season.

A plant that starts from seed in the spring and dies after it produces seed is called an "annual." Its life from seed to seedpod is called a "generation." In California, Luther could get two and perhaps three generations each twelve months, whereas in Massachusetts he could get only one. Each generation of plants, when you are trying to work magic with them, is a necessary step in improvement. Only rarely does improvement come in the first generation. Luther realized this and that is why he wanted to live where he could grow about three generations a year.

Meanwhile, he was living where inventive genius turned naturally to mechanical devices. In New England, at that time, even a boy whose mind turned to experiments with plants was certain to try making things with tools. Usually, whatever Luther did had a practical value, and now that he wanted to save money, he gave more attention to the making of things which could be sold.

He had experimented with a steam whistle. Using an old teakettle with a whistle fastened to the spout, he demonstrated to the astonishment of his young friends that steam has power—at least, power enough to blow a whistle.

Luther then developed this idea further, and, eventually, had built a small steam engine which had enough power to move a rowboat through the water. He sold this

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steam engine and gave the money into his father's care to save for his trip to California.

Because of his son's mechanical ability, his father thought that Luther should become a mechanic. It happened that his uncle, Luther Ross, was superintendent of the woodworking department of the Ames Manufacturing Company, at Worcester, Massachusetts. Luther's father arranged for the boy to work for his uncle.

Luther was interested in this work, not only because he wanted to earn money, but also because he liked mechanical things. Probably mechanics came second to working with plants, among the things he liked to do.

His job at Worcester was the turning of plow rounds on a lathe. He was paid fifty cents a day. But while he was away from home, he had to pay for his board, and his board cost fifty cents a day. He worked six days a week, but as he had to pay for his food on Sunday the same as on any other day, he earned, each week, fifty cents less than he spent.

This did not appeal to his practical nature, so he asked his uncle if he might work by the piece—if he produced more plow rounds, he would be paid more. When his uncle agreed, Luther made twice as many rounds in a day as he had made before, and earned twice as much money. Then he had something left to save for his future.

Even this advance in earnings did not entirely satisfy

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him. He was always watching for a method by which he could improve his work. One day, he went to his uncle with the announcement that he had built a device with which he could turn out many times more plow rounds than was common on the ordinary lathe then used. This attachment which he had invented enabled him to earn as much as sixteen dollars a day!

Perhaps this unusual success should have made him satisfied with a career as a mechanic and inventor. But the great amount of dust which he breathed in the woodworking shop was a detriment to his health. He had never been as strong physically as others, although he was very active. Now, the dust had such a bad effect on him that he had to leave his uncle's employ.

He returned home and devoted his time to the raising of fruits and vegetables for the local market. Even in this work, he used his inventive genius. One of the first things he did was to build a dam across a stream on his father's land to make a larger cranberry bog. Cranberries must grow where there is plenty of water. And, in order to have a larger crop, Luther made a larger area on which the cranberries would grow.

The railroad engines of that day burned wood, and Luther's father sold wood from his timberland to the railroad. One day, while Luther was working near the rail-

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road track, he discovered a fire which had been started by sparks which flew out of a belching railroad locomotive. Already his father's timber was threatened.

It was three miles to town where Luther knew he must get help, and the only way to get there was to run. It was a hot day, but Luther started running. He secured the necessary help, but he was partially overcome by his excessive exertion in the hot sun and was ill for many days. This experience weakened his health even more and proved to be another reason why he never went back to the wood-working shop or to mechanics as a career.

While the doctor was caring for him during his illness, Luther, as was his general custom, asked many questions. Information about the human body interested him so keenly that he concluded he would like to be a doctor. The local physician took an interest in him and helped him study medicine for a year.

Luther might have gone on with this study, because he liked it tremendously, but at about the end of that year his father died. Later, the family moved to a near-by town called Groton, and there Luther began his future work in earnest, again devoting all of his time and energy to the raising of vegetables for sale.

Now there was real responsibility; Luther's savings had helped the family in the emergency, and he must find a way to make more money. So he was continually looking

for improvements in vegetable growing. He observed, for example, that his customers were eager to have sweet corn as early in the summer as possible. It occurred to him that if he could produce sweet corn earlier than any other gardener, he could ask a higher price. But since it would take too long to produce a new variety that would mature earlier, he invented a method which could be put to use at once.

About a week before it was possible to plant corn in his garden, he put the seeds in a pan of shallow water where they swelled and started to germinate. Then, when he placed them in the ground, they had a start and would grow to maturity many days before the corn grown in other gardens. In this way, he was able to have sweet corn for sale before anyone else. He gained many new customers and also received a higher price for his early corn.

But he did not stop thinking about the ways of Nature, which must be understood in order to achieve these practical results. In these years when Luther Burbank was growing to manhood, one of the world's greatest scientists, Charles Darwin, was conducting experiments and writing about them in England. About the time Luther was twenty-one years old, he was given one of Darwin's books entitled *Animals and Plants Under Domestication*. This book enabled him to be even more certain that he

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could contribute more to this world by creating new varieties of plants than by any other kind of work.

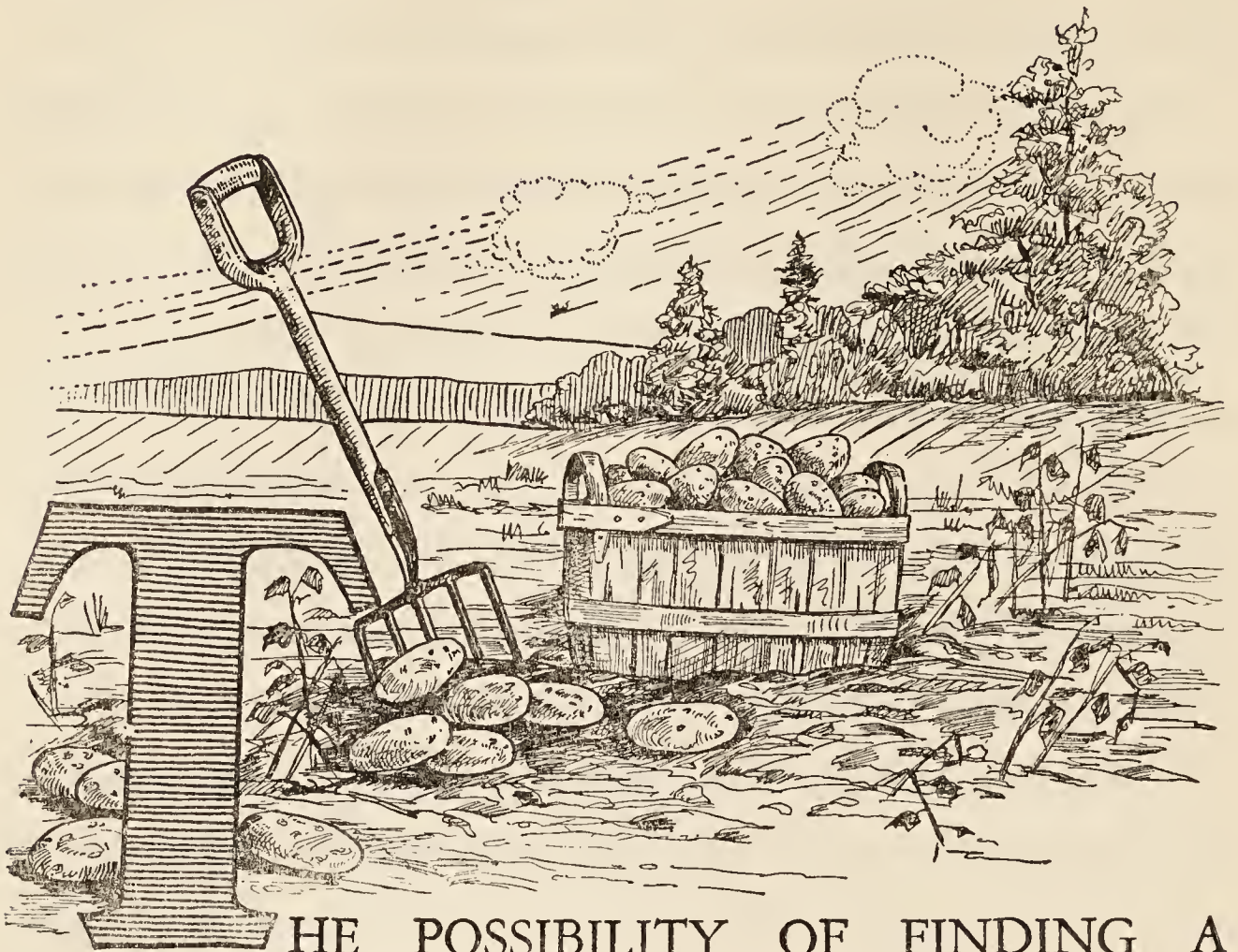
He read every word in Darwin's volume carefully. He made use of the principles it described, and he became more and more sure that what he wanted most was to be free to spend all his time producing new plants.

The fact that no one else had ever done just what Luther Burbank wanted to do was no discouragement. During his whole life, he was stimulated rather than discouraged when someone told him that what he wanted to do could not be done.

Although he was now only twenty-one years old, he had learned many times that Nature has few limitations in what she can produce. He had also demonstrated that man can aid Nature and help her to mold new lives of any type desired.

He still had the ambition to go to California. His success as an inventor, he believed, merely demonstrated that he could create new plants. After all, a new plant is an invention just as much as a steam engine of original design is an invention. This principle has now been recognized, and a new plant may be patented just as a new machine may be so protected.

5. POTATOES PROMISE A FUTURE



THE POSSIBILITY OF FINDING A future in a potato patch would not occur to many young men; and Luther Burbank had no such hope in his mind one day when he was going through his potatoes; he was looking for potato bugs. To him, each plant was like a personal friend, and he did not want an enemy bug to eat a single one.

Suddenly he stopped in amazement. He saw a little round green ball. It was not a potato bug, but something seldom seen on potatoes. Luther Burbank's future was actually inside that little green ball.

Luther knew what it was; knew the possibilities of using it as a source of money for his move to a climate

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where he could grow three generations of plants each year. For the little green ball at which he was looking was a seed pod. In it, he was later to find twenty-three seeds, each one of which would grow into a potato plant on which a new variety of potatoes would be produced.

It is not often that a potato plant produces seeds. For many generations we have grown potatoes by cutting the tubers into pieces and planting them; now the plant seldom produces a seed.

This little seed ball was not yet ripe; in fact, it was only beginning to grow. Luther knew that he would have to be patient for many days before it would reach its full size. He knew that he would have to wait until the seeds had ripened before he dared to pick the pod from the plant.

Thrilled with the prospect, he wanted to stay in the garden and protect that little green ball all day and all night. His mother didn't agree with that idea, however, and so he had to trust the tiny sphere to the elements and hope that nothing would happen to it to prevent him from planting the seeds.

The plan which developed in his mind during the first minute after he saw the seed ball was that he would grow new varieties of potatoes and sell them to a seedsman. He would go to California with the money thus secured.

Of course, he had no assurance that any of these seeds

would grow into varieties which would be of any value whatever. He had experienced many disappointments with other seeds; never yet had he produced a new variety that was worth more than the old kinds. But these experiences had taught him that he must be patient, and he never lost hope. He knew that it was impossible to foretell when a new and better variety would appear.

A TRAGEDY IN THE POTATO PATCH

Every morning after that, Luther rose early and went to the potato patch. There he stood, looking at the little green ball containing the seeds on which he felt his future depended. He examined it at different times during the day. Every evening, before he went to bed, he made sure that the seed ball was still safe. And after he went to bed at night, he dreamed of the plans he would carry out with the money he expected to get from the new varieties of potatoes.

One day when the seeds were nearly ripe, he went to the garden to dream a few more happy dreams about his future in the warm climate of California. When he came near to the plant where the seed ball had been growing, his heart almost stopped.

The ripe seed ball was gone!

Who could have taken it? Who, except his mother,

knew it was there or knew its value? He had not spoken to anyone else about it.

Without seeds, he could not produce new varieties of potatoes. Potato seeds grow so seldom that he had no idea when he might find another seed ball.

What chance had he of getting the needed money now? The few potatoes he could sell from this crop would not bring very much. The real prospect for his future lay in that seed ball which was now gone. What was he to do?

Luther dropped to his knees on the soft earth. Nervously, he turned over every piece of dirt. He examined every quarter inch of space under the plant on which the seed ball had grown; the seeds were not there.

He looked under the next plant, and the next one, and the next one. He had made up his mind that he would examine every inch of ground in the garden.

It was growing dark when his mother called him for supper. He didn't want to give up the search, but he could not hope to hunt again until daylight.

For several days, he hunted in vain. Finally, one evening, when his mother called him for supper, he answered with a shout: "I've found it! I've found it!" He shouted at the top of his voice. "I've found it, Mother!"

His mother, of course, was astonished. When Luther showed her the seed ball, she laughed and said, "You shouldn't get so excited about a little thing like that."

"Little thing?" repeated Luther. "Mother, this is the biggest thing in my life! With this seed ball, I may be able to get enough money to really get started!"

"What do you mean—get started?" asked his mother.

"I want to create new fruits, vegetables, trees, and flowers," announced Luther.

"That is a worthy ambition," his mother agreed, "but I do not know how you are going to learn that business. It takes a scientist to do work like that."

"I know how to do it now!" declared Luther, with a confidence which amazed his mother. "I have been reading books and talking with scientists and I know just what to do to make new plants. If I plant the seeds that are in this seed ball, a new kind of potato will grow from each seed. Some of the new potatoes may be no good; but some of them may be better than anything we now have. If they are, I am going to sell them and get enough money to go to California."

"If you get enough money from selling the potatoes that come from those seeds," his mother promised, "you may go."

Luther felt this was the happiest day of his life. He knew, of course, that it might happen that not a single seed in that ball would produce a potato that would be as good as those already in existence. Later on, he planted thousands of potato seeds secured from all over the world,

and was able to select only one new plant which produced potatoes which he thought were better than those already being grown in the United States. It is not often, therefore, that a potato seed will produce a new variety which will be useful.

But now Luther felt that, somehow, he was going to get what he wanted. Something told him that next year he would have the long-awaited chance to begin his real work.

Luther guarded the seed pod all through the winter. In the spring, he planted the twenty-three seeds which were inside the pod, and each one grew. Those twenty-three potato plants were given better care than any plants ever had before, and when the time came to dig the tubers, Luther still had confidence that he was going to get what he wanted.

He dug the potatoes which grew on the first vine. There was no question but that they were of a new variety. But the tubers were worthless. They were small and twisted.

The second hill was just about as disappointing as the first one. But Luther did not lose hope. There were twenty-one more hills to be dug.

Number three proved to be worthless; and so did number four.

Number five looked much better, but Luther was in

doubt as to whether it was as good a potato as the Early Rose variety from which the seeds had been taken.

Hill number six yielded beautiful potatoes. They were large and smooth and white. There were eighteen in the hill. Luther could not be sure, but he felt that here was a variety that might be sold.

The next one he dug looked even better. After he had finished digging all the hills, he believed that he had obtained two new varieties which were better than any potatoes he had ever seen.

The young man believed that these new varieties were what he had so long hoped for, but he knew that he must test them by growing a crop before he could sell them to a seedsman.

He planted both kinds in separate patches the next spring, and harvested the crop in the fall. One gave him more than twice as many bushels of potatoes to the acre as were commonly grown when tubers of other varieties were used. The other one did not yield quite so well. So he decided that the best-yielding variety was the one to be sold.

He sent some of the tubers to two seedsmen, asking them to make him an offer. One seedsman sent back word that he was not interested. The other one, Mr. James J. H. Gregory, of Marblehead, Massachusetts, sent word that

he would try the new potato in his own garden and let Luther hear from him later.

Luther planted this new variety again, and the next fall, after his own harvest, he received word from Mr. Gregory that there was a possibility of his being interested in buying the new strain. He invited Luther to come to see him, and Luther asked a friend of the family, Mr. J. T. Brown, who was a banker in a near-by town, to go with him.

After the visitors had introduced themselves, Mr. Gregory showed them a basketful of potatoes. They were large and smooth and white.

"These are the best potatoes I have ever seen," said Mr. Gregory. "I grew them in my garden. And I grew them from tubers which this young man sent to me a year ago."

Mr. Gregory asked Luther if he would sell him the potato outright, giving him the exclusive right to introduce it. This was exactly what Luther wanted to do. He much preferred to have at once the money to which he was entitled, so that he could use it to go to the Pacific Coast.

When the banker asked Mr. Gregory how much he was prepared to offer, Mr. Gregory said \$150 cash. Luther had hoped that he might get \$500. Mr. Brown tried to

persuade Mr. Gregory to pay more, but the seedsman said that there was a strong likelihood of other new potatoes being introduced, and he couldn't afford to pay more than \$150 for Luther's crop. Finally Luther agreed to this price, and the money was paid.

Mr. Gregory let Luther keep ten potatoes to take with him to California, and gave him the right to introduce them there. The seedsman said he believed the new variety should be named the *Burbank Seedling*, because a person who produced a new variety deserved to have it bear his name.

The young man's heart was bursting with joy. His thoughts already in California, he said scarcely a word to Mr. Brown as they drove home together, but the banker offered some good advice.

"You won't have too much money to start on," said Mr. Brown, "but if you are careful, and if you work hard—above all, if you hold to your purpose to produce new plants for the benefit of mankind—you can be sure of making a living."

Luther followed this advice. Throughout his life, he never allowed the desire to get money to change his purpose in any way; his first desire was to produce new plants which would benefit his fellow men.

In time, the Burbank potato was used so extensively, especially in the northwestern states, that not less than

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\$17,000,000 worth of this one variety was grown each year.

It is hard to realize that mankind can benefit so much from the result of one tiny seed. But who can say whether, if Luther had not hunted earnestly for the lost seed ball, and then planted the seeds it contained, the world would have the benefit it now enjoys from the wide use of the Burbank productions?

6. THE GREAT ADVENTURE BEGINS



WHEN LUTHER RETURNED HOME with \$150 cash, he was eager to leave at once for his new home. However, he owned seventeen acres of land, tools, seeds, and other equipment which must be sold before he could go. It took some time to dispose of these various salable articles, and then, with all his available funds gathered together, he had only a little more than enough money to pay his railroad fare across the continent.

When the day of parting came, he bade his mother good-by with mixed feelings of regret and happiness. He was sorry to leave his mother, but his clearly formed ambition to experiment in producing new plants made him

THE GREAT ADVENTURE BEGINS

realize that he was doing the right thing in going where his work could be carried on more effectively.

His mother prepared plenty of food for him to carry on the train; and in addition to a few extra clothes, his baggage further consisted of seeds of various kinds with which he wanted to work in California—and the ten Burbank potatoes. Without a doubt, it was the box containing those ten Burbank potatoes which gave him greatest comfort on this long, lone journey of three thousand miles.

Poring over maps of California many times before he left Massachusetts, Luther had finally concluded that he would go to the little town of Santa Rosa. The name was attractive, but more than that, investigation of the country convinced him that this was an ideal location for the kind of work he wanted to do. So he paid his fare to Santa Rosa.

Railroads were not so well developed in 1875 as they are today, and the trip from New England to the Pacific Coast required nine days at the best. Moreover, the train did not always keep up to the schedule. But whenever there were delays, some of which amounted to an entire day, Luther would open the box of Burbank potatoes and examine each of the ten specimens carefully.

Before he arrived at his new home, he knew every spot, every eye, every wrinkle, on each one of those ten tubers.

He recalled again what he had learned earlier in life: No two things in Nature are exactly alike. Each one of those ten potatoes, although they were all of the new Burbank variety, had its own individuality.

Perhaps, they were better companions for him than human beings would have been, for they encouraged him to plan for his future. They gave him confidence in what he had already accomplished, and they were an inspiration to lead him on.

One day, the train came to an unexpected stop far from any town. No houses were in sight in any direction. When Luther took advantage of the opportunity to get off and walk a short distance, he discovered that the reason for the stop was a hot axle. The trainmen told him that they would have to wait until the axle cooled, which would be sure to take two hours, and possibly longer.

Luther walked a short distance out on the prairie and saw many interesting plants with which he had not formerly been familiar. This gave him an opportunity to dream of improvements that might be made in those plants. Any farmer would have called them weeds, but Luther saw the possibility of beauty and usefulness in each one. He was soon to have the coveted opportunity to work for such improvements.

When he returned to the train, he was informed that there would be a further delay of two or three hours. As

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a matter of fact, the train did not get started on its way again until the end of the day.

Luther went back to his seat and read from one of the books he had brought with him. He had read the entire book before—many times, in fact. But he pored over it again, benefiting from what he read more than the first time, because of the experiences he had enjoyed since the first reading.

He had marked certain passages on previous readings. Those passages now meant even more to him. He had seen more of this great country of ours, and realized the need for improved plants which may be used by farmers to produce food and clothing and other essentials for human beings.

With a stubby pencil, he drew a diagram on the blank page at the end of this book. On this diagram, he divided a plot of ground into several sections. This was his imaginary experimental garden. He decided to plant in one portion the ten potatoes he was guarding so carefully. Next he made room in his garden for all of the seeds he had brought from Massachusetts, and allowed additional space for seeds which he had gathered on the prairie while the train was waiting for the axle to cool.

As he was tracing this diagram, he realized that he would need money to support himself after arriving in California. He must allow space in this imaginary garden

for producing vegetables which could be sold immediately; but this brought him to the stern reality that land is not bought without money. He would have to work at whatever occupation he could find until he could save enough to buy the land he needed.

While the train was stopped on the prairie, one of the passengers came and sat down in the seat across the aisle from the young man and talked to him. Luther listened attentively, learning that this man had lived in Santa Rosa and was able to supply information about the little town.

Then his fellow-traveler asked what was in the box. Luther opened it and displayed the beautiful white *Burbank* potatoes.

"Where in the world did you get potatoes like that, young man?" asked the stranger.

"It is a new variety," explained Luther, "which I produced myself."

The man laughed loudly. "You produced a new variety of potatoes? Why, young man, don't you know that scientists and professional horticulturists have been working for years to get a variety like that? A young fellow like you couldn't have done such a job."

"Well," said Luther, "I *did* do it. I raised this new variety from seeds which I found on my Early Rose potatoes in Massachusetts, and I sold the right to introduce them to James J. H. Gregory, of Marblehead, Massachu-

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setts. He gave me enough money for the Burbank seedlings to enable me to buy a ticket to California, where I am going to produce more new plants. I'm going to devote my whole life to this work."

By this time, the stranger had stopped laughing, and was looking at Luther seriously. "I can almost believe what you say," he admitted. "But where in the world did you get such an idea?"

"I have had the idea for many years," Luther explained. "My father's cousin, Professor Levi Sumner Burbank, helped me to get books and information which I needed. Then I talked with Louis Agassiz, and I learned more things from him. But most of what I know has been learned in the fields and in my own garden. Nature has helped me more than any man."

"Go on, young fellow," urged the stranger. "You interest me."

"Nature taught me," continued Luther, "that every plant that comes above the ground is different from all others that exist. Yet it is possible to reproduce that plant so that others which come from it will be quite similar and will have the same important characteristics."

"I have seen Nature demonstrate this many times. If you wish, I will take you out here on the prairie, and prove to you that there are no two flowers in that little patch of asters there which are exactly alike."

"You are pretty sure of yourself, aren't you?" commented the stranger.

"Yes, sir," agreed Luther. "I have examined many groups of plants, and found that there is always a difference between the separate individuals. So I am not afraid to say that I can show you differences in the blossoms in any patch of flowers, no matter whether I have ever seen the patch before or not."

"What else have you learned?" encouraged the stranger. "Tell me more."

"I have learned," continued Luther, "that when seeds grow on a potato plant, each seed will produce a new variety. That is how I was able to produce this Burbank Seedling which I have shown you."

"How about the seeds of apple trees?" asked the stranger.

"Every seed from a fruit tree also produces a new variety," said the young plant magician. "Fruit trees of the same kind are reproduced only by grafting. The bees and other insects take care of the crossing of pollen on fruit trees. The crossing has been done for so many generations that fruit tree seeds are already prepared by Nature for the production of new varieties."

"Well," said the stranger, "you seem to be so certain that I am now going to ask you a question which will cer-

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tainly confuse you. If Nature is so lavish in producing new kinds of plants, how is it that this prairie is not literally covered with millions of new varieties?"

"I can answer that question, sir," said Luther confidently. "The new variety begins as a single individual. The old varieties grow in great numbers. Single individuals cannot always thrive in a place where they are in competition with older established kinds. It is rarely that a new variety gains headway because the established kinds crowd it out. That seems to be Nature's way of preventing inferior varieties from taking the earth. It is the better variety only that succeeds."

"Oh," said the man, "you are propounding the theory of the survival of the fittest."

"Well," said Luther, "I don't know whether that is the theory I am propounding or not. I have never called it that. But I have observed in Nature that only those plants which are strongest survive and reproduce themselves. And it seems to me that hardiness is the chief essential for success. So I'm going to make it my first principle; I'll introduce only those new plants which demonstrate hardiness. They must be able to live in competition with others, and survive under difficulties. I am not going to introduce new plants which must be pampered."

"Well," complimented the stranger, "I must say that

you have high ambitions, and I wish you the greatest of success. Evidently you have put much more thought on this subject than I have, even though I am in the nursery business in California. Perhaps I will be your competitor."

"We must have competition," said Luther. "For, just as plants demonstrate their hardiness against competition, so man must do the same thing. If I am not hardy enough in my work, you may prevent my thriving by selling your products to all of the customers to whom I should like to sell."

"Oh, don't be pessimistic," said the man. "I'm not going to interfere with your plans."

"I'm not pessimistic," said Luther. "I'm simply telling you that I understand the importance of hardiness. No matter how beautiful, how juicy, how sweet a fruit may be, it shall never bear my name unless its growth is sufficiently hardy to withstand the vicissitudes of a scorching summer sun and the trials of a cold winter."

"Well spoken, young man. Well spoken!" approved the stranger, as he walked away.

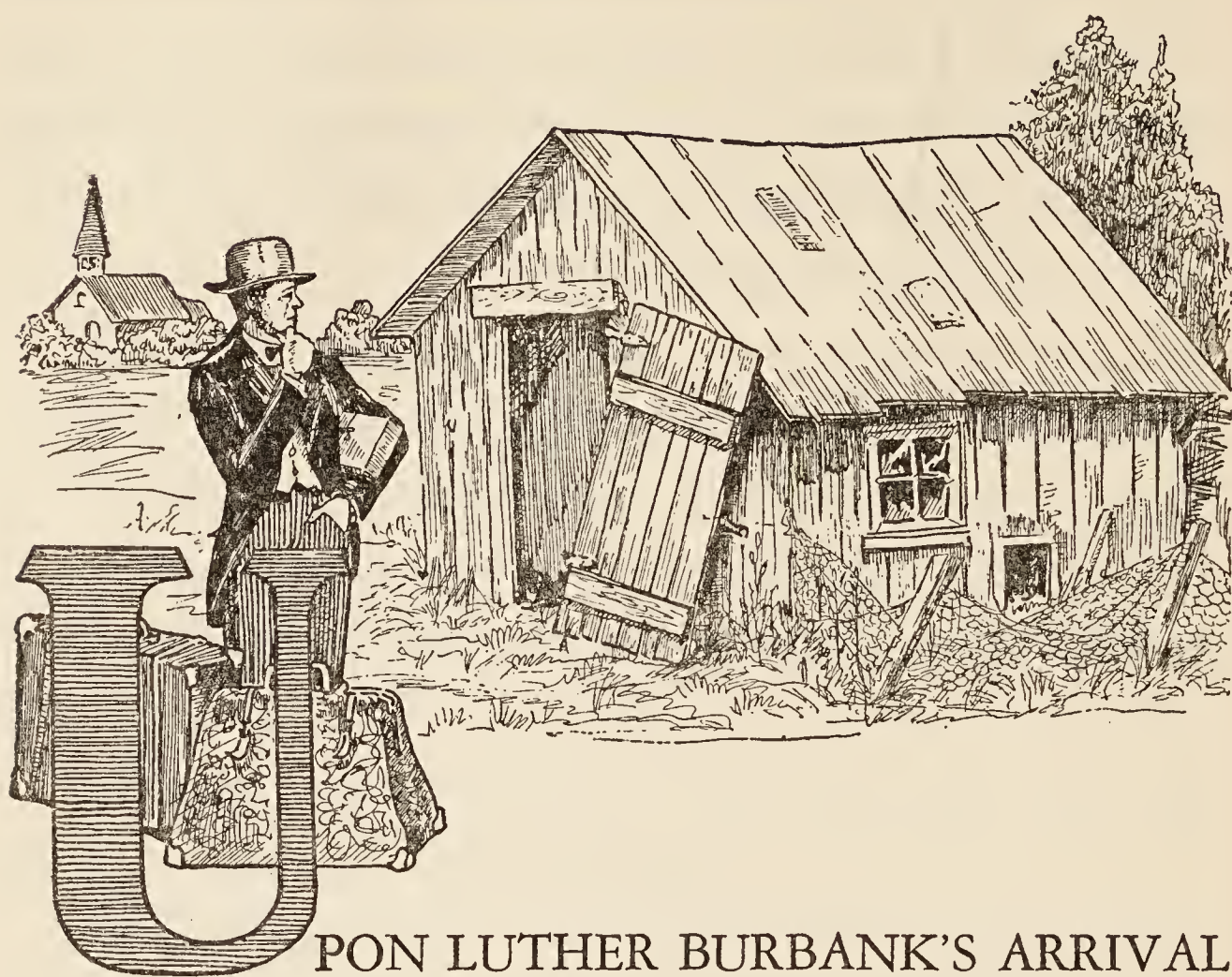
It is not surprising that this conversation added greatly to Luther Burbank's confidence. He had stated some important principles which he had never before put into words. This stranger encouraged him to put his thoughts,

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his dreams, into words, and to make a pledge to himself.

Now that he had said these things, they seemed more important than ever to him. Hardiness was to be his basic principle of plant creation. And hardiness remained his basic principle as long as he lived.

7. LUTHER DOES THE IMPOSSIBLE



UPON LUTHER BURBANK'S ARRIVAL in Santa Rosa, California, there was no one at the train to meet him. No one in Santa Rosa knew that he was coming.

Having very little money, Luther first had to get work to support himself. About the only employment which seemed to be available was the driving of teams of oxen or mules which pulled the heavy plows used to prepare the soil for wheat. But Luther was not a rugged young man; since the time when he was overcome by the heat when he ran three miles to help save his father's timber from fire, he had not been able to stand heavy work in the sun.

He walked alone through the few streets of the little

village. At that time, Santa Rosa did not have even a sidewalk. There were no vineyards, orchards, or ornamental trees. The town was surrounded by wheat fields. Luther observed an opportunity for a free night's lodging in a small building near the edge of town. It proved to be an unused chicken house. After dark, he went to this building, placed some hay from a haystack near by on the floor, and in this chicken coop he enjoyed his first night's rest in what he believed to be a country of opportunity. It was quiet in that abandoned chicken house on the edge of town, and he was happy. He had the satisfaction of being in a climate where his ambitions might be realized. He was just as sure that he was going to succeed as anyone could be.

The next morning, he came to a place where a building was being constructed, and applied for a job. The contractor told him that if he would furnish his own shingling hatchet, he might come to work.

Luther went to a hardware store and spent his last dollar for a shingling hatchet. When he returned to the building, the contractor told him that another applicant had come ahead of him and that there would be no employment. An explanation of what Luther had done in spending his last dollar for the hatchet did not change the decision of the contractor. Fortunately, though, Luther

was able to get his dollar returned by the kind-hearted hardware merchant when he explained the situation.

There were very few days during the remaining months of the year 1875 on which Luther Burbank was sure that he would have enough money to pay for his next day's food. Such an experience would discourage most young men, but Luther kept his spirits high.

"Every problem," he said to himself, "is merely a step toward success."

Each day he was able to get the necessary food, and, finally, in the fall of 1876, he secured more permanent employment from Mr. W. H. Pepper, of Petaluma, a town about thirteen miles from Santa Rosa.

Mr. Pepper owned one of the few nurseries in California, and Luther was happy because he was going to do the kind of work he liked. He worked in this nursery through the winter and into the following spring. Mr. Pepper had a building known as a "hothouse" in which plants were started, and Luther was allowed to use a room above this hothouse as a place in which to sleep. But after a few months, this undesirable lodging and the hard work he had to carry on during the day in order to satisfy his employer, caused Luther to become ill. He returned to Santa Rosa and went to the home of a friend, who gave him the care and the fresh milk he needed during illness.

Through many trials of this sort, Luther did not appeal

for financial aid to his brothers who lived in another town. In the first place, he knew that they were having their own problems; and in the second place, he was sure that they did not entirely approve of his plans. He could hear them saying to each other, "Who ever heard of such an insane idea as wasting your life working with weeds and plants which Nature herself ought to know how to handle?"

Even practical nurserymen did not applaud the ideas that Luther had, for no one had ever made a living as a plant improver. The creation of useful new plants as a life's work was an impossible venture, so far as practical men were concerned, and they told the young man what they thought with plenty of emphasis.

They hoped that the plain facts would discourage him, and turn his thoughts to other employment. But Luther was not to be discouraged. Past experience had taught him that, if you know what you want most, you can get it if you persist, and plan, and work, and keep up your courage. He had long before concluded that a man's saying that something is impossible does not necessarily make it an impossibility.

"Such a statement," Luther had often said to himself, "simply means that the man making it does not know how to do what he says is impossible."

Luther had not yet been able to plant the experimental

garden which he had drawn on the fly leaf of the book the day his train was stopped on the prairie. But he had taken the ten Burbank seedlings to the home of one of his brothers, and his brother had allowed him to plant them on a part of his land. These ten tubers produced a crop of potatoes in the fall, which Luther retained to be planted for the next year's crop. After he harvested the second crop, he began to sell the tubers to potato growers and this brought him a small income.

The people of California had been accustomed to a red potato. They were not easily persuaded that a white one could be as good, even though it was larger and yielded much more. A little at a time, however, the popularity of this new vegetable grew in the Pacific states, until in a few years it became the chief variety of potato grown there.

Luther was later able to get a small piece of land near Santa Rosa, and gradually he developed a small nursery from which he sold both potatoes and trees. He did the work in this nursery in his spare time, after spending the day at carpenter work. The day's work was harder because it was not nearly so interesting to him as his work with living things.

In those days California was not recognized as a fruit country as it is now. For that reason, Luther's nursery

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business grew very slowly. His first sale of fruit trees was in the year 1877. The careful accounts he kept of all he did, show that the income from the sale of nursery stock that year was \$15.20. In 1878, his returns were \$84. In 1879, his income from trees was \$353.28. The next year, he earned \$702. The following year, he sold \$1,112.69 worth of fruit trees and flowers. He was making progress.

Such ability did this young man display in the selection and growth of fruit trees that his income continued to swell until, in 1887, he sold over sixteen thousand dollars worth of nursery stock.

One reason for this pleasing success was that Luther Burbank had demonstrated that he could do the impossible. The first performance of what every local nurseryman called an impossibility occurred in the year 1881.

A Mr. Dutton, a wealthy merchant and banker of Petaluma, California, had developed a sudden interest in prune growing and wished to establish a large prune orchard quickly. Mr. Dutton, who had met the young Santa Rosa nurseryman, came to see him in March of 1881. He asked if Luther could furnish twenty thousand prune trees ready to set out the coming fall. Other nurserymen had said that growing prune trees in one season would be an impossibility. In fact, everyone knew that it could not be done—everyone but Luther Burbank.

Mr. Dutton agreed to furnish what money was necessary to carry on the project during the summer, and Luther agreed to produce the trees.

He had experimented as a boy in the grafting and budding of fruit trees. He knew that a tiny bud cut from a prune tree could be grafted onto the root stock of any other tree which belonged to the same genus.

He knew from experience, also, that the seeds of almond trees sprout quickly and grow rapidly. The almond is closely related to the prune. So Luther concluded that he could produce twenty thousand prune trees in one summer if he were to transfer buds from prune trees to the trunks of fast-growing almond seedlings.

His experience in making sweet corn grow more rapidly was also knowledge on which he drew in this case. He determined to care for the almond seeds in such a way that the roots would develop rapidly and quickly provide a trunk on which to graft the buds from the prune trees.

Luther rented five acres in addition to the two acres he already had. He secured enough men to help him plant the almond seeds and, as soon as the seedlings were ready, to transplant them into rows in the nursery.

He spread the almond seeds on a well-drained bed of creek sand and covered them with coarse burlap cloth.

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This, in turn, was covered with sand about an inch deep. In this way, he could lift up the burlap and examine the almond seeds without disturbing them.

The seeds sprouted quickly, and as soon as any were ready, they were transplanted. By the last of June, some of these new almond trees were ready to receive the prune tree buds. By the first of December, the twenty thousand prune trees were delivered to his customer.

According to what the older nurserymen had said, Luther Burbank had accomplished the impossible!

Naturally, Mr. Dutton did not hesitate to tell all his friends about the young nurseryman who had produced prune trees in one season. Never before had a prune orchard been created in one year. It is easy to understand, therefore, that Luther's good reputation spread, and his nursery business succeeded. It appeared that his ambition to devote his entire time to the production of new and better plants was soon to be realized.

With the money he received for the prune trees, Luther purchased four acres of land in the very heart of what is now the modern Santa Rosa.

It was a neglected piece of property which the owner had tried to sell for a number of years. Everyone considered the land to be very poor. No crop had grown on it for a long time. But Luther had examined it carefully and

concluded that it was just what he needed for his experimental work. The land had been the bottom of a pond at one time, and so it was rich soil. He had eighteen hundred loads of manure spread on the four acres. In this way, Luther made a rich soil—the kind he knew he would need for the work he was now to follow in earnest.

He first planted fruit trees on this land, and by the end of the second year he had sold enough of these trees to pay the cost of the four acres as well as to pay the workmen.

He now had the land ready and there were no debts to be paid. In a few years, this four-acre plot was to support more new plants, and a greater variety of strange plants, than ever grew on four acres anywhere in the world.

He had also earned enough by this time to buy a farm at Sebastopol, seven miles away, on which the soil and conditions were more favorable for the growing of fruit trees and certain other plants.

The selling of new varieties of plants is not like the selling of nursery stock. However, the satisfaction to an ambitious young man like Luther Burbank is far greater. He knew that, for at least several years, he might not have as big an income from the selling of new varieties as he had from the selling of nursery plants. So he continued with his nursery work as part of his project for three or four years.

LUTHER DOES THE IMPOSSIBLE

The year 1885 marked the beginning of his specializing as a plant inventor. He had at last, at the age of thirty-six, reached the point at which he could devote his entire time to doing what he had set out to do.

8. PLANT MAGIC WORKS WONDERS



HERE WAS A TIME, WHEN LUTHER Burbank, as a small boy, went to a theater with his father and there saw a magician change a black cloth into a white one. The magician rolled a large piece of paper into a tube, pushed the black cloth into one end with his wand and the cloth soon came out of the other end perfectly white. The magician then unrolled the paper, and the audience was satisfied that the black cloth had turned white.

After Luther became a successful plant improver in California, he started to work on the blackberry with the idea of making it white. But this trick could not be per-

formed in as short a time as the trick of the magician he had seen in Massachusetts.

As a matter of fact, the two tricks are entirely different. The magician had not actually changed the black cloth into a white one. He had a piece of paper in which there was a paper pocket. The black cloth was pushed into this pocket after the paper had been rolled, and a white cloth was pulled out of another pocket at the other end of the cylinder. The audience did not see these pockets. So, after all, what the magician had done was to create an illusion. The people *thought* they saw a black cloth turn into a white one; actually, there was no change whatever.

Mr. Burbank's job was to make a black berry really white, and he could not do it by trickery. The berry must be white, not only in his garden, but wherever the plants grew.

The magician changed black to white to entertain his audience. The plant improver proposed to change black to white to make blackberries more delicious, more palatable, and more interesting. In short, his job was something more than just to change the color. Far more, in fact, for he must at the same time change the flavor, the size, the productiveness; and he also wanted to make an earlier-bearing blackberry bush.

Hearing of a wild blackberry growing in New Jersey which was said to be white, Mr. Burbank had some of the

LUTHER BURBANK

small bushes sent to him. But the berries were small and not good to eat. Furthermore, they were not white. They were a yellowish brown. However, they were not black and Mr. Burbank thought he might use these plants in creating what he wanted.

So he crossed them with the best of the black blackberries which he had. His favorite for this purpose was the Lawton. He liked its flavor, and it was a popular berry. Everyone who grew it liked it, but Luther Burbank felt it could be improved. The berries were not so large as they might be, and they were jet black.

With the seeds from this first crossing, work was only begun. Not one of the seedlings bore white berries; all were black. But he transferred the pollen from these seedlings to the flowers of the wild blackberry, and crossed the pollen from the wild one with the seedlings. In the next generation, he found some bushes whose canes were a lighter color. When the cane of the bush is a light color, there is some likelihood that the fruit may be light also. So he was encouraged.

When you are working with Nature, you may expect many curious things to happen. One of the seedlings from the first cross had an unexpected characteristic: it bore black berries, but it continued to bear both flowers and fruit the year around. Also, it continued to grow in

height. By the time it was three years old, the top could not be reached without a stepladder. However, the berries were small and showed no signs of whiteness. It was only a novelty, but an interesting one, for it showed what strange things may come as a result of crossing.

When the lighter-colored bushes of the second generation bore fruit, this fruit was also a lighter color. It was not white, but it might be described as a "yellowish white."

These bushes were selected for further tests. The pollen from their flowers was crossed with other seedlings, and the seeds thus produced were planted. Some of the new varieties which resulted from this last cross bore berries of a clear crystal white, so colorless that the tiny seeds inside could be seen through the translucent pulp.

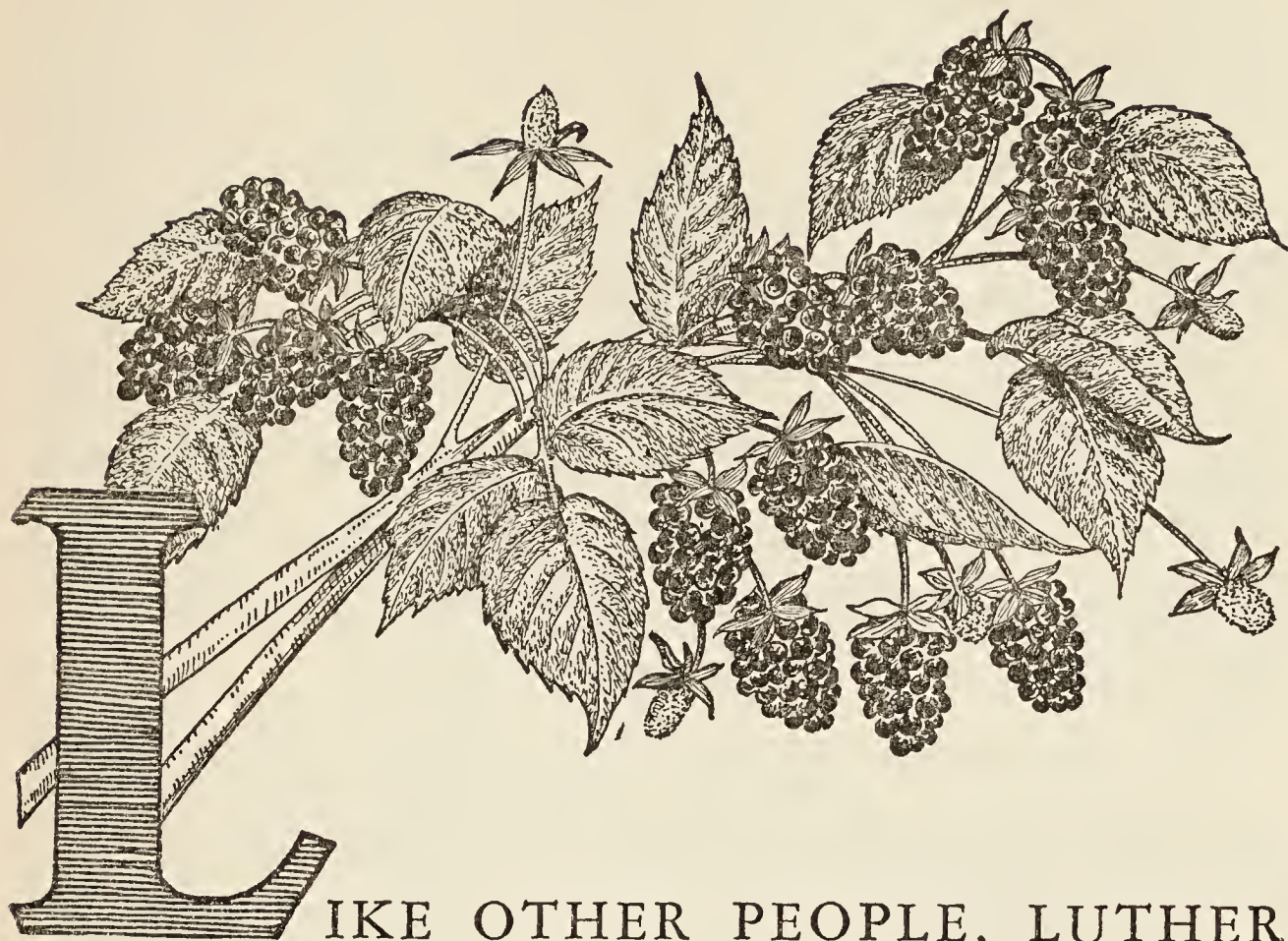
However, there were only four or five bushes bearing these white berries, out of a total of several hundred. One of the white fruiting bushes was selected as best and when it was multiplied a white blackberry was available for the market.

The new berry, which was named *Iceberg*, had not only a clear crystal white color, but bore large berries with a delicious flavor. There were a few thorns on the bushes because, in this case, the effort had been to produce a white berry rather than a thornless bush. The bush was

prolific. It bore great quantities of these delightful berries. There was no tinge of yellow in any of them. Every little ball in each berry was pure white.

The work of producing this white blackberry occupied several years. And today, while the white blackberry has not taken the place of the black one, there are many people who enjoy the *Iceberg* blackberry, for they can grow it in their gardens.

9. BERRIES WITHOUT THORNS



LIKE OTHER PEOPLE, LUTHER Burbank was annoyed by the long hard thorns on blackberry bushes, which scratched him as they scratched anyone approaching a berry patch. So he set about remedying this situation. The nursery rhyme about the man so wondrous wise that he first scratched out his eyes in the bramble bush, then scratched them in again, might well have been written about this plant wizard.

Luther Burbank reasoned with other naturalists that plants developed thorns for their protection. But, he thought, if we give plants their proper care they should have no need of thorns; and so he set out confidently to disarm the blackberry.

His work to get a thornless blackberry began in 1880. At that time, he purchased a blackberry called the Wachusett thornless, which had fewer thorns than other varieties. It did have some, and so was not truly a thornless blackberry. However, he used it as one of the parents in making crosses with thorny blackberries.

Later on, he got another variety of berry which was known as the "wild dewberry," and which was also nearly thornless. The seed produced by crossing these nearly thornless berries with others, produced two or three new species which were almost without thorns.

Then these were crossed, and among their offspring he found several more which were without thorns. This was the second generation from the original crossing. He then raised more than 15,000 seedlings from the seeds of the best of these thornless plants, and out of that large number, none of the new varieties of the third generation had thorns. All of them were without any sharp points anywhere on the plant.

But he considered that their fruits were not good enough to introduce.

The dewberry, which was one of the parents he used, was a plant that trailed on the ground rather than stood upright. To insure an upright shrub, and at the same time a better fruit, Mr. Burbank used the Lawton blackberry pollen to cross with these new thornless kinds. He

BERRIES WITHOUT THORNS

hoped by this method to secure a smooth bush which would bear delicious berries, and that is exactly what he found on his Sebastopol farm one day in 1911, more than thirty years after his first work with blackberries.

My own work in recording his experiments had just begun when one day he came rushing into my office and said, "Beaty, at last I've found it! It's wonderful! It's delicious! It's the most superb flavor I have ever tasted! After all of these years I finally have it!"

"But what is it, Mr. Burbank?" I urged. "Tell me what you have just found."

"A thornless blackberry," he said.

"But, Mr. Burbank," I reminded him, "you have had thornless blackberries ever since I have been here."

"Oh, but those thornless bushes out here have fruits that are insipid," he said. "They are tasteless. They are worthless. The bushes have no thorns, but the fruits are not good. This morning I found the one I have been working for all these years.

"Just to take the thorns off is not enough. The fruits must be better than any other blackberry fruit. And at last I have it! There is one new variety near the fence at the west end of my Sebastopol place which I shall introduce. The stems on that plant are so smooth that you could rub them over the face of a baby without injuring it in the least. There isn't a sign of a thorn anywhere.

LUTHER BURBANK

And the bush is prolific. The berries are large and glistening. And the flavor is delicious. Beaty, I have it at last!"

It was this enthusiasm which helped Mr. Burbank to keep on working even after he had experienced the greatest disappointments.

This work with blackberries was interesting because it was necessary to cross back and forth between thornless and thorny bushes. Every alternate generation of seeds produced only bushes with thorns. A characteristic in a plant which has existed for unknown generations is likely to be much more difficult to change.

People who saw Mr. Burbank's new thornless blackberry agreed with him that it was the most beautiful and the best-tasting blackberry they had ever seen. The fruit was large and a glossy black, it had an excellent flavor, and the bushes bore in abundance.

To produce blackberries with those characteristics he used the same simple method he had employed when he first experimented with the oxeye daisies in his mother's garden in Massachusetts. He carried pollen from one flower to the other, and planted any number of seeds, until he finally got the one ideal plant toward which he had been working.

A STONELESS PLUM IS PRODUCED

The stage magician Luther Burbank had seen when he

A STONELESS PLUM IS PRODUCED

was a small boy could make a silver dollar disappear from a locked box. This trick came to his mind one day when he thought, "What a splendid trick it would be if I could remove the stone from a plum without breaking the skin."

He reasoned that, in a commercial orchard, the stone is not needed, for the seeds are not to be used for reproduction. Nature had to provide the stone, because, without the help of man, the protection was needed to keep mold from the seed and to prevent decay until the time of sprouting. However, it requires a great deal of food and energy on the part of the plant to produce the shell to protect each seed, and this seemed to the thrifty plant magician to be a waste. He wanted to remove the shell so that the tree might use all its energy for the production of fruit, seed, and leaves.

One thing that stimulated him to attempt this apparently impossible feat was news from France of a small wild plum which, in itself, was absolutely worthless, but which had very little shell surrounding its seed. In fact, the plum was called "Sans noyau," which means "without a seed covering." He secured some plants of this wild plum, but when he had grown the fruits, he discovered that there was a rim of stone more than halfway around the seed kernel.

The fruit itself was no larger than a cranberry, and

was not good to eat. Nevertheless, he thought he saw a value in partial stonelessness because he knew that if he crossed the pollen from this species with blossoms of good plum trees he would likely produce new plums which would have almost no stone.

Crosses were made between this wild plum and several cultivated varieties. At first, the fruits were of no practical value except that many of them were stoneless. Each had a seed, of course, but the seed was not protected by a stone. Therefore, Mr. Burbank made further crosses, and this crossing of hybrids on hybrids was kept up until success finally crowned his efforts.

His first crossing was with the French prune. The prune, it must be understood, is a plum which can be dried for future use. In other words, all prunes are plums, but not all plums are prunes, for many plums crack when they dry, and become useless as human food. As a matter of fact, the skin of the prune must crack very slightly also in order to allow for the evaporation of the moisture.

Many of our good prunes are delicious when used as plums and they are shipped from the fruit sections to the larger cities where they are sold as plums. But the remainder in the commercial orchard may be dried in the sun and later shipped as dried prunes.

Mr. Burbank often remarked that the removal of spines or the removal of a stone is comparatively easy.

A STONELESS PLUM IS PRODUCED

The difficult part was to produce a stoneless fruit which was of delicious flavor and large size, and which grew on a tree desirable in every way for commercial growing. Also, it must have the shipping qualities so necessary to enable it to be transported from the fruit section to the large cities where it is needed.

Stonelessness, therefore, was fairly simple to get in the early generations of these crosses, but good quality of fruit was not found until after about ten generations.

The first of the stoneless plums introduced by Mr. Burbank was named *The Miracle*. This was sold to the Oregon Nursery Company in 1903. In 1911, the first stoneless prune was introduced by him under the name of *Conquest*. This was a much more desirable plum than the *Miracle*, for not only could it be shipped as a plum, but it could be dried as a prune.

One of its parents was the French prune, and in the French prune, about five per cent of the total bulk is made up of the stone. The *Conquest* was as good as or better than the French prune, and not more than one-tenth of one per cent of the total weight was stone. The stone did not cover the seed, but there was a very small semi-circular shell near the edge of the seed.

This new prune, the *Conquest*, had a golden, sweet flesh. It was borne on a tree which was a rapid grower, and produced an unusual quantity of fruit. Well named,

it marked one more conquest over difficulties by the plant improver.

During about forty years' work, Mr. Burbank introduced sixty new plums. While a few of the first were seedlings which Nature herself had produced, most of his introductions were created by crossing the pollen of one kind with another, planting the seeds, and then selecting the best.

His crossings produced new fruits of the widest variety. Some would be one color, some another. Many were absolutely worthless, but a few gave promise of being better than any formerly produced. These, of course, were tested further, and those which developed no bad characteristics were grown in larger quantities in order to give Nature an opportunity to bring out any weaknesses which might make the plums undesirable.

After these plum experiments were under way, Mr. Burbank usually had about thirty thousand new varieties coming into bearing each year. More will be told about them in later chapters, and a partial list of the Burbank plums will be found at the back of the book.

10. HOW THE MAGIC WAS PERFORMED



BY HELPING COMPILE NOTES and set down records of experiments, it was possible for me to gain a clear idea of Luther Burbank's working methods; and he himself clearly recalled the effort behind every success. Once he stopped in the midst of the description of one experiment, and said, "No, no, you make that seem too easy. It was hard work!"

When people read of the almost unbelievable success of a great man, they are often inclined to think that this success came in some mysterious way. It is seldom that they realize how slowly and laboriously it was built.

Mr. Burbank did not consider himself a genius. He did not believe that he was the only one who had the

formula for creating new plants, that it was impossible for others to carry on in the same way. But he could not forget the years of disappointments, the days of crawling between plant rows on hands and knees, the nights of making records.

Sometimes, when I watched Mr. Burbank at work, it seemed to me that his senses were more highly developed than my own. He seemed to be able to recognize a shade of color that I could not see; his sense of taste was better educated than mine. When I commented on this, his answer was prompt:

"I doubt that my senses, to begin with, were any different from those of others. But it may be that, because I use my sense of taste, my sense of smell, and my sense of sight more than most people for distinguishing slight variations, my senses now react more quickly.

"We are standing," he went on, "at the edge of an acre of land on which I once found a sweet-smelling calla. It may be that my experience in this case will help to answer your question."

Then he told me the story of an earlier experiment which illustrates his way of working and explains how the amazing results were obtained.

Those who saw Luther Burbank as the fortunate recipient of world honors might find it hard to believe that

HOW THE MAGIC WAS PERFORMED

he would spend hours crawling on his hands and knees through an acre of callas to smell of each blossom. Yet he did that very thing—and it brought him fame.

He had long wished to produce a calla with a sweet scent. He loved the graceful form and the color of the white flower, but the odor of those previously in existence was unpleasant.

“If,” he thought to himself many times, “I could retain this beautiful form and color and add fragrance agreeable to man, I could contribute a great deal to the pleasure of human beings.”

With that thought in mind, he set about to produce such a flower. Of course, he was looking for other improvements as well, but a sweet-smelling calla was his chief objective.

At length, he had an acre in which there were many blossoms larger than those of the parents from which the new varieties had been developed. There were some with tiny blossoms, but so perfect in form that, because of their small size, they were much more attractive than some of the larger ones.

There were white blossoms and yellow blossoms. There were pleasing blossoms and those that were not pleasant to look at. But the odor from all the blossoms was disagreeable; it was the common odor of the calla.

Day after day, he had walked through this acre with-

out discovering any other odor. But one evening, as he approached the field, he detected a pleasant scent which stood out above the other less agreeable odors.

He walked down the first row, and, as he walked, he was sure that his nose had not deceived him. At last, he had a sweet-scented calla! But in that acre, there were certainly ten thousand new varieties, or more. The question was, which was the sweet-smelling blossom? He walked here and there but could not determine where the pleasing fragrance might be located. Yet he could smell it, no matter to what part of the acre he went, and that was satisfying, because here was a pleasant scent strong enough to stand out above ten thousand bad-smelling flowers.

He knew that he could not afford to put off finding that flower even for one day; on the following day, the fragrance might not be so easily recognized. He knew that there was no way to find it except by the use of his nose.

So he got down on his hands and knees, started at one corner of the field and smelled every blossom until he found the one he wanted. It was not the second or third or even the fifteenth or fiftieth blossom. He had to work until long after dark, and probably smelled three or four thousand blossoms before he finally found the one which was sending out its message of good will to

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mankind. Then, thankfully, he marked the plant by tearing off a white strip from his handkerchief and tying it around the stalk.

He named it *Fragrance calla* and began plans for multiplying it so that it might be further tested and later introduced.

This early triumph was one of the plants which helped to make the fame of Luther Burbank—a fame which spread not only over all of the United States, but over all of the world. Great scientists from everywhere came to Santa Rosa to see him and to learn of his methods. So we may say with some truth that Luther Burbank crawled on his knees to fame.

When Luther Burbank, as a boy, built something mechanical, he worked with only one unit. But when this same young man started to work with flowers, he then had to work with thousands.

There is no end to Nature's ability to produce variations. However, never was he able to tell, even after he had years of experience, just when Nature would produce the new plant he wanted. The more seedlings he grew, the shorter was likely to be the time it would take to find the improvement he was looking for. As a matter of fact, there were many experiments which did not result in any desirable new plant. But, in every case,

he progressed faster if he used thousands of seedlings, rather than two or three.

The nine steps in his plan for producing new kinds of plants were:

First, he carried the pollen from one flower to another. This process was not limited to two flowers only. He made the crossing with so many blossoms that, usually, he had thousands of seeds as a result. The plants which were crossed in this way were carefully marked and records made of the crossing.

Second, he harvested the seeds from these plants and cleaned them carefully so that there would be nothing but seeds capable of producing new varieties in the pan when the cleaning had been finished.

Third, he planted these seeds in shallow boxes called "flats."

Fourth, he watched these flats and, as soon as the new plants began to show themselves above the surface, he studied each one. Those who have never seen a quantity of new plant creations coming above the ground may not realize how surprisingly different they are. Some grow many times faster than others. Some have undesirable characteristics which can be recognized at once.

Fifth, the minute he discovered anything undesirable, Mr. Burbank destroyed those plants which showed the

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undesirable characteristics. Thus, many were destroyed before the plants were transplanted from the flats.

Sixth, after all had been eliminated except those which showed no fault, the remaining plants were transplanted into test beds. There they were given more room and the best of care. Every day, he examined each bed.

Seventh, if anything could be found to criticize, it was enough to doom the new plant after it was transplanted. Some plants in the test beds appeared to be more easily injured by insects or the weather than others; they were immediately destroyed. Some were there which gave off unpleasant odors, or developed colors that were not pleasing.

From day to day, therefore, the number of plants in an experiment decreased. While the improver started with thousands, he wasted no space by growing those which promised to be worthless.

Eighth, the best of the new plants were crossed, the seeds from the best were saved and other thousands of plants resulted—often millions were used in one experiment.

Ninth, in the case of tree fruits, it was necessary to go through another process which could not be used with the flowers. As soon as a new fruit tree had grown from seed to be tall enough to allow the removal of a tiny

bud or twig, the twig or bud was cut off and grafted on an older tree. Usually, this new variety then bore fruit the following year, or at least the second year.

If Mr. Burbank had waited until the original seedling had produced fruits of its own, he would often have waited six or seven years or more. But by grafting on an older tree, he obtained the fruit sooner.

Meanwhile, the little tree which grew from the seed was allowed to continue to grow and was kept carefully marked; for only from this tree could additional cions be obtained for the reproduction of the new kind if it was to be introduced. Of course, a few cions might be obtained from the tiny branch which was grafted on the test tree, but the original tree was the one commonly used.

This brief review of the work is likely to make it appear that it was quite simple and easy, because reading of methods and results takes only a few minutes. But to produce one new variety worthy of introduction required years of painstaking toil. Thousands of seedlings were destroyed for every one that proved to be useful.

For example, the routine of producing a new plum started with individual trees brought from Europe, Asia, and the east coast of America; most Burbank plums have this ancestry. As the blossoms of these three trees opened, Mr. Burbank, early in the morning before the bees started

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to work, picked the flower from one and scattered its pollen on the pistils of flowers on one of the other trees. A record was made, a label placed on the stem on which the fertilized blossom grew; and when the fruit ripened in the fall, it was picked, carefully marked, and the seeds preserved until ready to plant.

Then the seeds were planted in a special soil mixture which, he had discovered, brought about quick growth. The plant magician studied the tiny trees as they came above the ground and thrust their first leaves upward into the sunlight. Over a period of years he had noted the characteristics of the leaves and the stems of the trees as compared to the fruit, and he could often tell what kind of fruit a tree would bear when he saw the developing seedling.

As with other plants, the new plum seedlings were examined for undesirable characteristics. Thorns doomed them to the bonfire. Mr. Burbank passed the growing plum seedlings almost every day, and whenever he saw one which was undesirable for any reason whatever, he consigned it to destruction. Nature would have eliminated it eventually, but he could help Nature and save space by eliminating it more quickly.

As those which gave some promise of future value grew larger, they were transplanted so that they would have more room in which to grow. Again, the weeding

out of the undesirable ones was a prominent part of the work.

After the cion was grafted on the older tree, he watched the cion more than the tree itself. If he saw any indication of weakness in the bark, leaves, or fruit, the cion was cut off and some other one grafted where it had been. "There is no place in my orchard for loafers," he often said.

The host trees were planted about three feet apart in the rows, and the rows were about five feet apart. By planting trees close together, he was able to get more on an acre. This again illustrates his desire to make the utmost use of everything, which perhaps was based upon his New England instinct for practical thrift.

Mr. Burbank's fruiting test plots occupied about three acres on the Sebastopol place. As he walked between the rows, he looked at every fruit, at every cion. If a fruit was ripe, he tasted it. If the fruit was cracked, he tied a piece of Manila twine around the stem on which it grew. This was the death warrant.

If, on the other hand, the fruit appeared to be as nearly perfect as he wanted it, and if it had a desirable taste, he tied a little strip of white cloth around the stem to indicate that this new variety must be preserved. If he was undecided, he did not mark the branch at all, but waited until it fruited another year.

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Day after day, during the fruiting season, he went through his plum orchard because there was something new waiting for his inspection every day. Yet hours of walking and careful observation often resulted in the discovery of not one new plum which was worthy.

When a plum was marked with a strip of white cloth, he looked up its record and located the original tree from which the cion was taken. He cut more cions from this tree and grafted them on the trunks of seedling wild plums to make additional trees which would bear only the new variety. Wild plum roots are likely to be more hardy than those of other varieties, so they are best for root stocks.

It was only in this way that more trees of this one new variety could be obtained. No other seed ever planted or ever to be planted could produce a plum exactly like the one selected; grafting was the only way to get additional trees for commercial orchard tests. This applies to plums, apples, pears, cherries, quinces, and other orchard trees.

If the seedling selected had enough branches on it to make twenty-five trees of the new variety, these trees were then grown under conditions which compared to a commercial orchard. They were allowed to come into bearing, and further tests were made to make sure that the fruit was all that was expected.

If anything then developed which made the fruit undesirable, all of the trees were destroyed; and the fact that thousands of dollars' worth of such plants were destroyed each year shows that there were many, many such disappointments.

In some cases, Mr. Burbank had a fruit ready for introduction five years after the seed was first planted. But it was more likely to be ten years or longer. Some of his best introductions were produced, not from the first crossing of pollen; nor from the third, fourth, fifth, sixth, seventh, or even the tenth—but from the twentieth or fiftieth cross. That is one of the reasons why he worked with thousands. If he had worked with only one seed at a time, he would never have accomplished very much. By working with thousands of seeds, at least one was likely to turn out to be of some value, although even that was not assured.

Many have wondered how we obtained our fruits before Mr. Burbank created new varieties. From the beginning of time, Nature has been a plant improver. Nature has crossed the pollen. She has the bees and other insects to do that work. She has made her crosses; grown the seeds; destroyed those which were not suited to their environment; and allowed those to grow which were worthy. However, Nature always required a much longer time when she worked alone than when Mr. Burbank

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helped her. One of his greatest contributions to Nature's creative laboratory was to speed up the process.

AT WORK ON A GRAND SCALE

Most of the magicians we see on the stage perform tricks which have been invented by others. They may vary the performance somewhat from the originator's technique, but the principles are the same. However, a good magician will, in addition to this, have some tricks which he has originated himself. The plant magician operated in somewhat the same way.

Luther Burbank never claimed to have originated the trick of producing new varieties of plants. He knew that Nature had invented the method he used long before man knew anything about it, and he often said that the basis of his work was Nature's method of plant improvement discovered by Charles Darwin and described in some of that scientist's early books.

He secured seedling plants wherever he could find them. If Nature herself had made the necessary crosses to produce variations, and if a seedling from these crosses turned out to be worthy of introduction, Mr. Burbank did not hesitate to introduce it; after all, it was as much his discovery as if he had made the original cross. For the most important part of a plant creator's work is the selection of those varieties which are worthy of introduc-

tion to the general trade. It requires the greatest knowledge, the keenest development of senses, and a willingness to destroy all plants except those which are far better than any others in existence.

Such perfection did Mr. Burbank reach in the grafting of seedlings that he had as many as thirty thousand new varieties come into bearing each year. He grafted many new varieties on one older tree; each branch of the older tree was able to support a cion from a seedling. Thus he might have as many new kinds of fruits growing on a tree as there were branches.

No one before his time had developed this method of speeding up the completion of Nature's efforts to create new varieties. But Mr. Burbank wished to create as many new varieties as possible, as soon as possible. He saved time for himself and Nature by using all the shortcuts he could discover.

No doubt one of the most important principles was that which required destruction of the useless plants. Mr. Burbank had a space on the Sebastopol farm to which he carried all of the plants which were to be destroyed. There he accumulated a huge pile, and once a year, set fire to these worthless creations. He called it his ten-thousand-dollar bonfire, because he estimated that it had cost not less than that to produce the fuel which went up in smoke in an hour.

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Those who saw the size of this bonfire often agreed that this estimated value was probably much too low. The important thing about the bonfire, however, must be emphasized again. That is, Luther Burbank was willing to destroy promptly any creation, no matter how interesting, which he was sure would be less valuable to man than what man already had.

Many are so proud of what they produce that they are never willing to destroy any part of it, even though it will never be of service. But in order to work with thousands, Mr. Burbank had to have room. He had to have time. And if he had left these worthless plants where they grew, they would have occupied room and consumed time. An important part of his philosophy of life which made him the great man that he was, was simply this: "Time cannot be added to a person's life, but it can be made more valuable by avoiding waste."

SELLING NEW CREATIONS

When he had twenty-five trees of the new variety ready for introduction, his work was still not finished. He must find someone who would buy this new product, make many more trees by grafting, and distribute them to fruit growers who would produce thousands of tons of fruit for man's use.

If Mr. Burbank had not developed this part of his

work as successfully as he did, he might never have been known as the world's greatest plant improver. He had to be a salesman—even the proverbial better mouse-trap has to be sold. Even though he produced the best plums that had ever been grown, the world would benefit very little unless he sold them to distributors, for he was no longer in the nursery business.

One of his methods of selling to nurserymen was to publish a list of his new creations and offer them for sale. In the catalog, each new fruit was described in such a way as to make the nurserymen want to see it. Many of them visited Santa Rosa and Sebastopol and went away with purchases.

The price of these new creations varied a great deal. One new kind of plum which was named *Splendor* was sold to the Stark Brothers Nursery Company of Louisiana, Missouri, for \$3,000. For this \$3,000, Stark Brothers received the original seedling and the additional trees which Mr. Burbank had himself grafted, together with the right to introduce this new plum to fruit growers. Mr. Burbank did not retain any tree of this new kind but left the distribution entirely to the purchaser.

Stark Brothers purchased many other of his fruit trees and listed seventeen varieties of Burbank plums in the 1941 catalog. It is apparent from the listings of this one

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firm, sixteen years after his death, that his plums are still popular among commercial fruit growers.

An idea of the large size of many of Mr. Burbank's plums may be had from the description of one variety in the Stark Brothers catalog. This is Mr. Burbank's "Elephant Heart," and Stark Brothers call it "the most marvelous plum ever fruited since the world began."

The catalog says: "This plum verily seems too good to be true. Even after you have held one of these huge blood-red fruits in your hand, reveled in its exquisite lusciousness, you eagerly reach for another and find yourself ecstatically wondering, 'Can this actually be a plum?' It is a crowning quality triumph of Burbank's lifetime endeavor to develop finer fruits for mankind.

"The Elephant Heart is a freestone blood-fleshed plum. The individual fruits often measure two and a half inches long by two and a quarter inches thick. They are as big as a United States standard apple. They are dark red and pear-shaped in form. They are easily broken open and the seed drops out of its own weight. This makes it easy to eat.

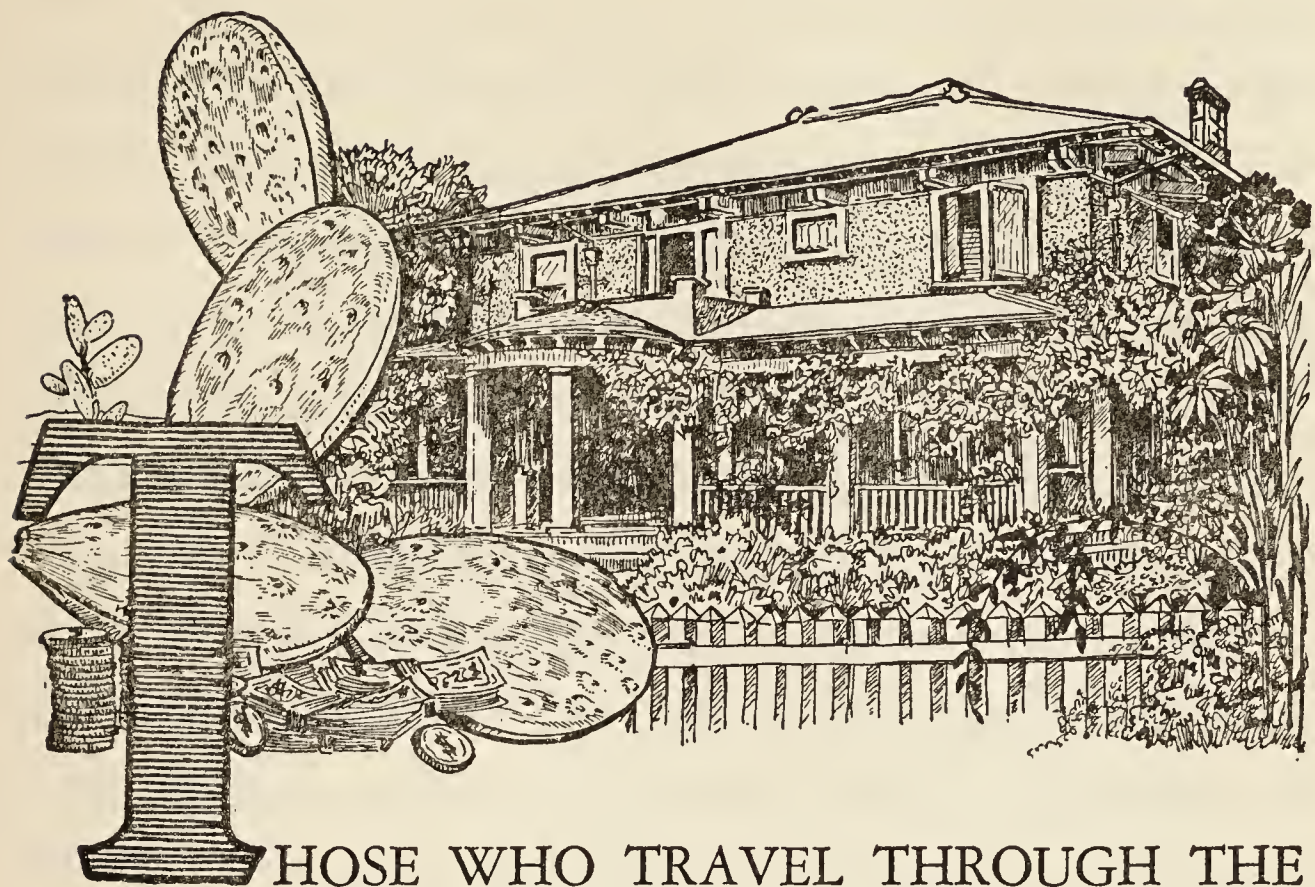
"Its other characteristics are: It is a remarkable shipper; it is wonderfully hardy, because it withstands the coldest weather; the fruit hangs long on the tree."

Catalog descriptions are proverbially glowing with

bright promise; but unlike the illusive patter of the stage magician, the promises of the plant magician were put to the test in bright sunlight, in home gardens and commercial nurseries, and there was never any dispute as to the "triumph of Burbank's lifetime endeavor to develop finer fruits for mankind."

Usefulness to mankind continued to be the guiding idea in all Luther Burbank's work, and this explains some of his preferences as well as his methods. It would appear from the fact that he did not introduce as many new roses as plums, for example, that he did not care so much for the roses. As a matter of fact, he often admitted that he really enjoyed working with the trees more than with the smaller plants. Somehow, the practical value of the food produced by the trees seemed to appeal to his New England thriftiness, and while he fully realized the importance of beauty in developing our characters and creating inspiration for our daily lives, he devoted more time and more space in his garden to food plants.

11. FIVE NEW PLANTS BUILD A HOUSE



HOSE WHO TRAVEL THROUGH THE deserts of southwestern United States see many cactus plants. They grow far apart. And they grow slowly.

At least, they did until Luther Burbank took an interest in their value as food for livestock. In his conversations with ranchmen who lived in the cactus country, he learned that when a fire had burned the spines from a cactus plant without seriously damaging the plant itself, animals were seen to eat the cactus with great relish. Containing about ninety-eight per cent water, the most vital of all animal needs on the desert, a cactus plant supplies both food and drink to hungry cows.

After learning that livestock would eat the cactus when the spines were burned off, some of the ranchmen made

a practice in dry seasons of burning off these spines with torches. But this was such a tremendous job that it was not practical except in cases of the greatest emergency.

Luther Burbank determined that a worthy effort of his should be to produce a cactus without spines. More important, he wanted one which would grow more rapidly—a thousand times more rapidly—than those wild varieties which inhabit the southwestern sections where rain comes only two or three times a year.

When Luther was a very small child, his most loved toys were plants. Among the many kinds of plants which he frequently carried around, as other children carry toys, was a cactus which had no spines. He now recalled this plant, and as he studied further, he learned of some wild cacti which grow without thorns. But all cacti, up to that time, were slow growers. No practical crop could be grown with the varieties then existing.

The reason the cacti grow far apart on the desert is that each one must have a wide area of soil from which to absorb moisture when the rains do come in the spring. Because of the ability of the roots to take up moisture rapidly, and because of the design of the plant's stem, moisture can be retained; the cactus has a skin which does not allow much moisture to evaporate, and it has storage cells inside. Thus the cactus can often live for three years even though no rain comes.

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Concentrating on the cactus problem, Luther Burbank took into consideration those arid sections where water for irrigation could be obtained from near-by rivers, and also the semi-arid places having more rainfall than the desert. It seemed to him that a fast-growing, spineless cactus could be used where some water was obtainable.

Also he learned of other parts of the world where such a forage plant would be welcomed. He discovered that the great deserts of Australia are capable of growing the cactus, and ranchers of Australia said they would like to have a forage crop of this sort so that they might raise more sheep.

He proceeded to work for such an unheard-of plant in the same way he had worked for other products. Crossing the pollen from one plant to another, he used as parents both the spiny and spineless varieties. After studying the various kinds of cacti, he decided to work with that kind which is known as *Opuntia*.

The stem of the *Opuntia* cactus grows in sections. The *Opuntias* which he believed would be most useful are those whose sections are wide and flat. People who see a new section growing from the stem usually refer to it as a leaf. As a matter of fact, it is not a leaf, but a section of the stem.

What are now spines may once have been leaves with a broader surface. However, the cactus does not now

digest food in its leaves, as is the habit of most plants, but in its stems. Each slab of the *Opuntia* has chlorophyl in the outer surface, and this chlorophyl makes food from water and the carbon dioxide of the air in the same way that chlorophyl in leaves does a similar job.

Luther Burbank planted flat after flat in his greenhouse with hundreds of seeds resulting from the crosses he had made. As soon as a tiny cactus plant showed its head above the surface of the soil, he began to study it and make selections of those which promised to help him get what he hoped for. From the first, he worked to produce a fast-growing cactus without spines. In the end he produced not one variety, or two, or ten, but thirty-five. The cactus proved to be the most responsive of all the plants with which he worked.

My own experience with Mr. Burbank began while he was working on his cactus experiment, and I saw him go through every step in the process which produced results more astonishing than anything else he did.

"If you want to see me pollenize cactus," he said to me one afternoon, "come into the garden where the cacti are beginning to bloom."

He selected the blossoms of a cactus which was small and full of thorns. It was just opening its petals. The stamens were opening and were ready to shed their yellow life-giving pollen.

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He pulled a thick leather glove on his right hand and held the blossom with this glove so that the many tiny little spines would not get into his fingers. Then, with a long knife, he cut the blossom from its stem.

"It took me a long time to learn to do it this way," he explained. "At first I was so impatient to get results that I didn't bother with a leather glove. I picked up the blossoms in my bare hands, and many a day have I suffered from making that mistake."

He carried this amputated blossom to a cactus plant which was the result of previous experiments. There he turned the blossom upside down and rubbed its stamens on the pistils of the other flower, which was just opening.

"This is the way I do it," he said. "Some scientists would throw up their hands in horror if they saw me doing it in such a clumsy way. Most of the men who experiment with cross pollination cover the plant the day before with a paper bag. Then, the next day, they carefully pick the pollen from one flower with tweezers and carry it to another flower that was previously covered with a paper bag.

"That's all nonsense, as far as I am concerned. It is a lot better to get here before the bees start to work. Then you don't have to bother with paper bags and tweezers. The only thing that is necessary is to get the pollen to the pistil before any other pollen has reached it.

"Pollen starts to grow as soon as it touches the pistil. It goes down that long stem of the pistil and joins with the ovules inside the seed case. After it has started to grow, no other pollen can replace it. So, there is no reason to cover the flower after pollen has been put on it. No matter how many bees come, they can't change this combination I have just made."

Mr. Burbank then wrote in a book the date, the names, and the locations of the two plants which he had just used as parents for seeds which would produce new varieties.

Later on in the season, the fruits, which are commonly called "prickly pears," were ready to harvest. When we cut them open, we found many seeds inside. These seeds were carefully dried in a pan that was labeled, so that there was no question as to what plant they came from and what plant had furnished the pollen. The records of all of this work were kept in permanent books, which Mr. Burbank guarded carefully.

After the seeds were ready for planting, he planted the seeds from one fruit in a flat. The flats were kept in a greenhouse until the seed had germinated and the young plants were thrifty enough to be taken out of doors.

Each morning Mr. Burbank and I went to the greenhouse and examined all the flats. This one whose story

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we are telling showed a young plant thrusting its head above the surface in just a few days. I kept a careful record of my own and each day discovered more plants. That is, I counted the number of plants each morning, and found a larger number every time we examined the flat. But some of these new plants did not come above the surface until many days after the first one had shown its head. In other words, some were slow to start, others quick. Some were slow in growth; others grew fast.

After all the plants had a sufficient start in the greenhouse, Mr. Burbank took the flat out of doors and put it in a hotbed where glass windows could be placed over the top when he thought necessary.

In a short time, there were two cactus plants in one flat which were growing so much faster than all of the rest that Mr. Burbank thought it wise to transplant them so the others would have a better chance. He transplanted them into a bed and, again, he made careful records as to the parentage.

Only one of these fast-growers was without thorns. Nevertheless, he kept them both, in the hope that the thorny one would show characteristics which would be important to his work. Selections for transplanting continued for several weeks until the original flat was empty.

In the meantime, many of the new varieties which

came out of this flat were destroyed. All of those which grew very slowly, and some which grew fairly rapidly, but were covered with thorns, were thrown away.

It was not only the top part of the cactus which Mr. Burbank examined when he was discarding those which he believed were worthless. He examined the roots also. To grow rapidly, any plant must have a good set of roots. Roots of the *Opuntia* cactus usually are not so large, but there are many of them, and they grow long distances. As a matter of fact, a thousand small roots will gather much more moisture than one root as big around as the thousand put together. The surface of the root, containing the root hairs, is what gathers the moisture.

Search for weak characteristics continued as long as Mr. Burbank observed the new varieties. This job of selection is so important that many people have failed at this point. It is quite a simple matter to produce new varieties, but it requires real ability to *select* new varieties which are worthy of introduction. This ability is developed only by experience and study.

There were, at length, only three plants remaining from the seeds picked from the fruit which I saw Mr. Burbank pollenize. Two of them had no spines. These two were growing much more rapidly than the one with spines, although the spiny one grew at least a hundred

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times as fast as its wild ancestors. That is why Mr. Burbank saved it; it might be useful as a parent for further experiments.

The other two, without spines, had become large enough to propagate. Before a new plant is sold, a quantity of plants, all equally good, must be shown to the buyer in order to demonstrate that the plants will reproduce themselves with sufficient accuracy to make them of practical use. So, it is necessary with these new varieties of cacti to grow fifty or a hundred plants to demonstrate what others can do when they wish to plant a whole field.

The propagation of various kinds of plants is carried out in different ways. An annual plant is reproduced by its seeds. The potato is propagated by cutting its tubers into pieces and planting them. A plant like the dahlia is reproduced by separating its tubers and planting them.

The *Opuntia* cactus is propagated by breaking off slabs and thrusting one end into the ground. The common way is to dig a little trench so that the portion of the slab which was attached to the plant will be buried in the ground three or four inches—just deep enough to hold it upright. This slab will grow more slabs from several of the many eye spots which cover its surface.

So Mr. Burbank and I broke off a dozen slabs from each of the two new plants and carefully placed them in trenches. Those taken from each of the two plants were

labeled and records were made in the record book. In just a few days, each of these slabs sent out tiny sprouts from the sides and from the top edge. In a few weeks, we had a dozen large cactus plants in each of the two rows.

Mr. Burbank measured the area planted to some of these fast-growing cactus plants and, at the end of twelve months, he weighed every slab that had been removed from the measured area. Then he had an actual record of the amount of forage produced by each of the two new varieties of spineless cactus.

One of these new varieties, on a measured piece of land, produced the equal of ninety tons of forage per acre. A farmer who harvests four tons of alfalfa is well pleased with the returns from an acre of land for a season's use. But a farmer who can harvest ninety tons of cactus per acre may well be the envy of his neighbors. He is in a position to make more money from his farming, because the cost of feed is tremendously reduced.

The other variety, when tested, produced ninety-eight tons of forage per acre. But these were not the most prolific of Mr. Burbank's new varieties. He eventually produced one cactus which yielded at the rate of one hundred and fifty tons per acre, in the third season after the original planting of the slabs.

The cactus plant is a perennial. That is, it continues to

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grow year after year without being replanted. The only work in raising cactus is to cultivate between the rows, and harvest the slabs, which are tender and as succulent as grass. Their ninety-eight per cent of moisture has been converted into valuable food in the green slabs and is worth far more than ordinary water as nutriment.

It is not difficult to understand that such forage would be worth far more than alfalfa to those livestock raisers who live in dry areas where the cactus will thrive and where it can be irrigated. It is understandable then that it could be possible to sell one slab of the new cactus for one thousand dollars.

Mr. John M. Rutland of Australia, who bought the first five varieties of spineless cactus which Mr. Burbank sold, paid one thousand dollars for one slab of the new fast-growing plant. He paid almost as much for slabs of four other varieties. With the slabs, he bought the right to introduce these new kinds into the southern hemisphere.

These five new varieties were named: The Santa Rosa (the one for which Mr. Rutland paid a thousand dollars), the Sonoma (the name of the county in which Santa Rosa is located), the California, the Fresno, and the Chico. Later on, Mr. Burbank sold these same varieties for introduction in the northern hemisphere.

Let's consider the apparently fabulous price paid by Mr. Rutland of Australia, for five slabs of spineless cactus. Did he run any risk of losing these cacti by their failure to grow when they had finished their long trip halfway around the world?

Of course Mr. Burbank guaranteed that the cactus slabs would survive the trip to Australia or be replaced. He had made many tests which were much more trying than this trip halfway around the world. For example, he had hung a slab of cactus from a rope tied to the limb of a tree where it had remained in the hot California sunshine until it appeared to be thoroughly dry. He took it down, after many months, and planted it in the soil. It immediately sent out roots and started to grow.

When I arrived in Santa Rosa to work with Mr. Burbank, I was given a room in his old home, off which was a dark closet. One day as Mr. Burbank and I were talking, he asked, "Did you notice the slab of cactus in that closet?"

"No," I told him, "I have had no occasion to open the closet."

"Let's look at it now," suggested Mr. Burbank. He pulled back the curtain which had covered the door, and there on the floor, lay a large cactus slab. Upon it was growing a new slab which was fully ten inches long. It

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was entirely in the dark. It had no source of moisture other than that stored in its own body. It had no connection with the soil. Yet there it was growing under those circumstances. Mr. Burbank told me that the cactus had been in this dark closet twelve months.

This is an illustration of the hardiness for which Mr. Burbank always looked when he selected new plants. He would never interest himself in a plant which had to be pampered. It had to be able to withstand such vicissitudes as lack of food, lack of moisture, cold weather, dry weather, disease, and destructive insects.

After Mr. Rutland had been growing the spineless cactus for several years, he wrote to tell Mr. Burbank that the new varieties were thriving splendidly in Australia. The cactus was valuable every year, but in two different years of drouth, this fast-growing forage had made it possible for farmers to save the lives of thousands of sheep. Not only was he pleased with the results of his purchase, but he felt that the price paid was even less than the new varieties were worth.

With the four thousand dollars which Mr. Burbank received for the five cactus slabs, he built himself a new home. Up to that time, he had been living in a very small old house which was on his Santa Rosa land. He built his new home across the street.

In developing the spineless cactus, Nature outdid herself, with Luther Burbank's help. For, besides feeding cows and sheep, the plants provide an appetizing fruit for human food.

All the new spineless varieties produce fruits, and some of them were developed particularly for the value of their fruit. Prickly pear fruits may be bought in many cities today, and some of them come from Burbank varieties of spineless cactus.

Not all the fruits, however, are entirely spineless. Most of them have little clusters of spicules, which should be rubbed off with a heavy paper so that the fruits can be peeled. Inside is a delicious juicy meat, well filled with seeds. For a delightful breakfast dish, these fruits are cut into pieces about the size of a large strawberry, and eaten like strawberries with sugar and cream. They may also be cooked and made into preserves, jams, and jellies. Some housewives use them to supply a color to other fruit preserves, to ices, and to confections.

Burbank cactus slabs may also be used as food. The tender slabs, peeled and cut into slices, are fried in butter.

The juice of the slabs is a splendid ingredient for candy.

Many of the varieties developed especially for fruit produce tremendous quantities. One slab contained forty-three large red and yellow fruits.

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So prolific are some varieties of fruiting cactus that their production is not measured in bushels per acre, but in tons. As much as one hundred tons of fruit have been harvested from an acre of one of these varieties after it had matured and was producing its utmost in fruit each year. No other fruit crop of any kind has ever produced such a quantity.

These figures are so unbelievable that it is not at all surprising that many horticulturists who never visited Mr. Burbank's grounds, and so never saw the actual productivity of these plants, considered such statements false when they were first made.

However, those who saw how close together these plants grow, and how many slabs there are on a plant, and then counted as many as forty-five and sometimes fifty large fruits on a slab, could believe the weights given. Mr. Burbank weighed the fruits many times. He weighed them from measured areas and computed the total production per acre. He then published the figures in his twelve-volume autobiography.

The reason it is difficult for persons who have not seen a field of cactus to believe that there could be any such production is that their thoughts are based upon the spacing of trees in an orchard. Burbank's cactus plants can be grown as close together as hills of corn, and many varieties grow to be eight feet tall. The plant is literally

covered with wide long thick slabs which branch off near the ground and continue to branch out on all sides to the top of the plant. The fruits grow all over the surface of these slabs—not just on the end, or around the edge. Some of the individual fruits weigh as much as half a pound, although the average weight is less.

Fruits of different varieties are of different colors: white, various shades of yellow, green, orange, pink, purple, crimson, a vivid blood red; and some are such a dark color that they are almost black. The flavors are difficult to describe. In general, they do not taste like any other fruit. Most of them are slightly sweet. A few are slightly acid.

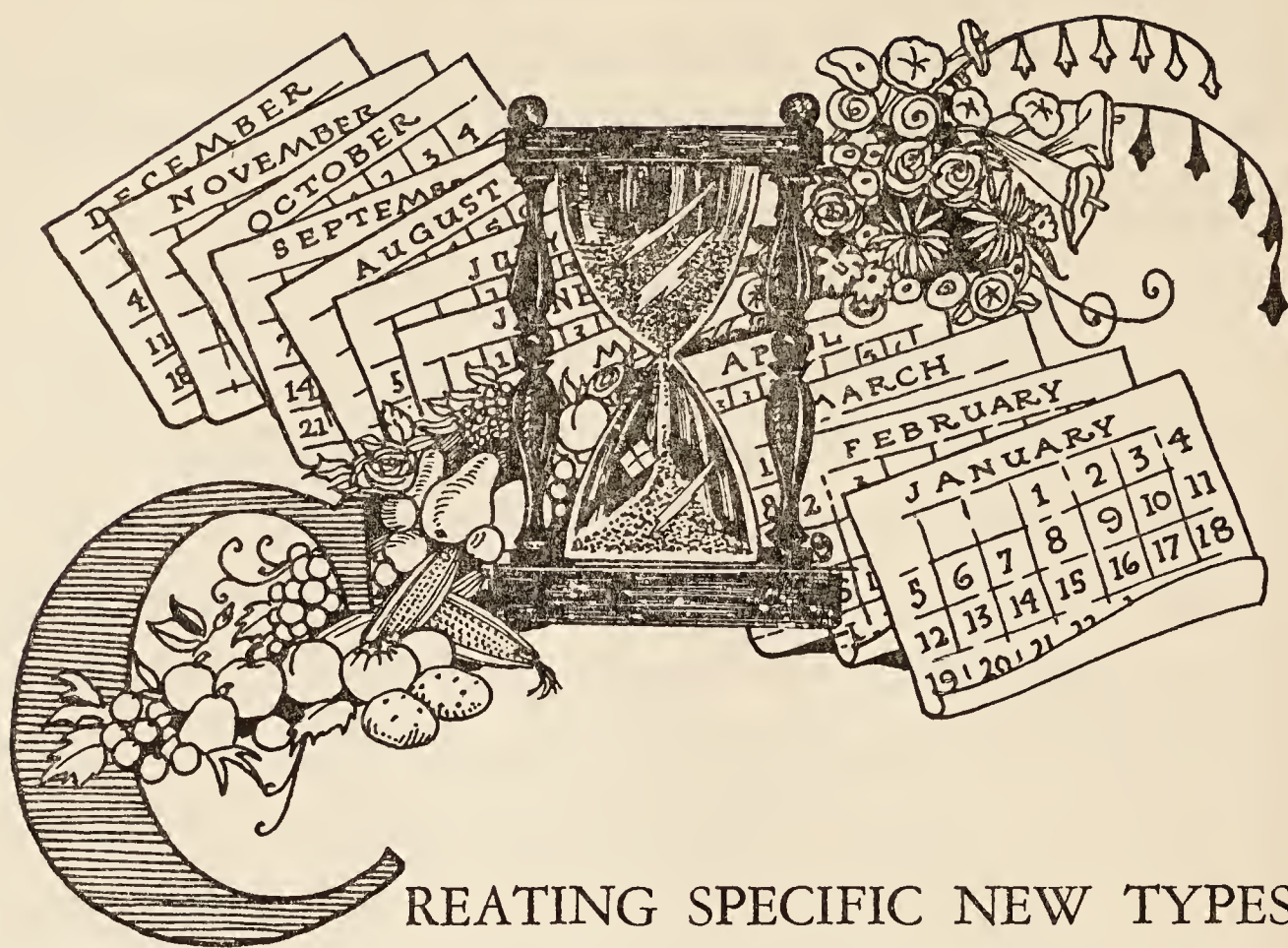
The fruits of the wild cactus have been used in many countries for many years, especially in seasons when other foods are not available. One summer, Professor Leotsakos of the University of Athens, Greece, told Mr. Burbank that the wild fruits of the *Opuntia* are used by millions of people around the Mediterranean Sea for about three months of the year. The Mediterranean peoples frequently soak the wild cactus fruits in sea water, which, they think, improves the flavor. Professor Leotsakos said that he preferred half a dozen good cactus fruits to the best beefsteak.

He was so pleased with the productivity of the new

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Burbank varieties, and with the size of the fruits, that he asked the officials of his government to import some of the new kinds to improve the food crops for the people of Greece.

12. NEW PLANTS MADE TO ORDER



CREATING SPECIFIC NEW TYPES of plants was not often done on order but one such order was received by Mr. Burbank in 1905. It came from a large canning company, so large that forty-six thousand cans of peas could be packed each hour in its canneries in Colorado and in several other states.

What the canning company wanted was a variety producing many pods of uniformly small peas which would all ripen at the same time. There were very important reasons for each of these three specifications. As to size, it had been demonstrated that people would pay a higher price for a can of peas if the peas were small, tender, and delicious in flavor. The larger peas are generally considered to have a less desirable flavor.

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The reason for wanting all of the pods to mature at one time was to accommodate the crop to the mechanical methods used in canning factories. Instead of picking the pods by hand, the mowing machine is sent through the field and the pea vines are cut off.

They are then raked up and hauled to the factory where they are put through machines which shell the peas. The peas themselves are then run over screens which sort them into sizes. This last operation would not be necessary if the peas were all of one size. Furthermore, if they were all of the right size, there would be a higher percentage of the best grade.

Of course, prolificacy was necessary in order to make the crop as profitable as possible.

IMPROVEMENT BY SELECTION

When Mr. Burbank accepted this commission, he knew that peas are commonly self-fertilized. He knew also that there is great variation among the vines which grow from a quart of seed. This simplified his work tremendously. It would not be necessary to make crosses; all he had to do was to grow a large quantity and select those plants which performed according to specifications.

Fortunately, he could grow two crops a year in California. That made it possible to have two generations from which to select, every twelve months. Therefore, in

three years, he was able to grow six generations and that was enough to produce the new variety which the canner wanted.

He selected for first consideration only those vines which were nearest to the requirements. He planted the seeds from these, and from the next generation he selected again for small size, prolific bearing, and uniform ripening. Of course, he paid attention also to the flavor of the peas. The third generation and the fourth perpetuated only those nearest to the ideal type. Finally, in the sixth generation, at the end of the third year, Luther Burbank had what he believed fulfilled the requisition.

He shipped the seeds of the new variety to the canning company. This company planted them and multiplied the quantity until, in the year 1912, it was able to plant hundreds of acres all of this one new kind. The new variety was named the *Empson* to honor the president of the canning company, Mr. J. H. Empson. But, when the peas were put on the market, Mr. Burbank's name was used on the label, and, of course, he profited from making this new plant to order in three years.

While Mr. Burbank was searching for this special type of pea, he also made selections for other qualities. He selected for large size and for prolificacy. He had some vines which produced four and five times as much as

others. While the larger-sized pea was not so desirable for canning, it did have a use in the home garden.

He paid most attention to desirable flavor, and he produced four new kinds in addition to the one the canner had ordered. Mr. Empson bought these four as well as the one producing the smaller peas. Thus, his company had varieties which were not available to competitors.

It should be emphasized again that this was all done without any crossing, for there are many plants which can be improved this way. Farmers have long known the value of selected seed, and when they pick their seed corn, many take only ears of the type desired, from the type of stalk which the farmer likes best.

In this way, corn has been developed to such an ideal state that the ears grow at just the right height on the stalk so that they may be easily grasped when they are being husked. Ears have been made to fill out all of the space on both ends, and have been selected to produce well-filled kernels in straight rows which grow close together on the cob.

While hybridizing is necessary with some kinds of plants, especially when characteristics of those which have grown far apart are to be combined, a great deal of practical work can be done by careful selection as Mr. Burbank selected peas to fulfill his specific order.

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Not only this experience, but all of his work demonstrated that plants *can* be made to order.

WEEDS PRODUCE A NEW FRUIT

Since the time when Luther Burbank had experimented with weeds in the cow pastures of New England, he had believed that there are possibilities for improving plants which have become pests to the farmers. While he worked with many different kinds which never produced anything of value, he succeeded with weeds of the Nightshade family to which belongs the so-called "deadly nightshade."

It was because the tomato is related to the nightshade that people were afraid to eat the tomato fruits many years ago. As a matter of fact the potato belongs to the same family, which also includes many weeds, two of which Mr. Burbank finally persuaded to unite.

One of these weeds has the scientific name *Solanum guinense*. Its original home is in Africa. Another one is named *Solanum villosum*. It came from Europe. It was Mr. Burbank's plan to make these weeds into a new plant which would be useful.

In addition to the fact that one of the weeds came from the southern hemisphere and one from the northern hemisphere, before being transplanted to the western hemisphere, the botanists classified them far apart. Mr.

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Burbank experimented with them for years before he could produce a single cross. He carried pollen from one to the other, but the blossoms thus pollinized did not produce seeds. However, one of his most valuable characteristics was his ability to continue year after year regardless of discouragement; and finally, in the season of 1905, his efforts were crowned with success.

He planted the seeds in his greenhouse, and when the seedlings showed their leaves above the surface of the soil, he realized at once that he again had something entirely new, although he could not tell whether the hybrids were of any value or not.

He transplanted them into the garden, and in time the new plants blossomed. One of them did not produce fruit, but the others bore fruit quite abundantly. The fruit was not large, and its flavor and other characteristics were entirely different from either parent. It looked somewhat like a large blueberry and it had a pleasing flavor, whereas both parents bore fruit with a flavor that could not easily be endured, and some plants of the family were poisonous.

Mr. Burbank selected two of the best plants among the twenty which grew, because they bore more fruit, the fruit was larger, and the flavor was more pleasing. The seeds of these hybrids were saved and they produced plants like the original seedlings when he raised two

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crops in one season in the mild climate of California. The fact that the plants reproduced themselves from seeds was complete evidence that he had an entirely new species.

He named this new plant the *sunberry*, and sold it to a seedsman for introduction. The seedsman, however, changed the name to *Wonderberry*.

Although the berry had some unfavorable publicity because of its parentage, it found a place in many gardens. It ripened late in the season after other berries were gone; it was as hardy as a weed, and it produced fruit which made delicious pies.

One enthusiastic grower wrote Mr. Burbank that a small patch of these fruits provided enough berries for a pie every day from early in August until the frost stopped the fruiting.

Its hardiness made it possible for customers in Alberta, Canada, and in Alaska to raise the *sunberry*. This was particularly pleasing to people there, because it was difficult to raise other berries.

The *sunberry* pleased Mr. Burbank tremendously because it demonstrated the usefulness of weeds as parents for the creation of fruit-bearing plants. Also it demonstrated the usefulness of the plant improver, for it is not very likely that Nature alone would have produced the *sunberry*. The parents lived a great distance apart. There wasn't much likelihood of their being combined except

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when man offered to help Nature bring them together. We may, therefore, conclude that Nature needs man's help to bring about improvements in living things.

POTATOES AND TOMATOES ON ONE PLANT

A plant improver's life is full of surprises. While Mr. Burbank made very definite plans and worked toward them, there were thousands of unexpected results every year. New types of flowers, vegetables, and fruits appeared in the course of his experiments, and they were often of the most astonishing shapes and colors. This is one feature of plant improvement which fascinates almost everyone.

Although his work was confined to practical experiments, Mr. Burbank sometimes made tests to increase his knowledge of the relationships of certain plants. For example, he had often wondered what would happen if he grafted a tomato plant on a potato plant. He knew that they belong to the same family group, called *Solanaceae*. But the potato belongs to the genus *Solanum* while the tomato belongs to the genus *Lycopersicum*. He thought they could be grafted, but what the results might be he could not tell.

So, cutting off the top of a tomato plant, he grafted it on a potato plant. Then he cut the top of a potato plant and grafted it on a tomato root. In other words, he made

the combination both ways. The results were astonishing.

The new plant which was tomato above and potato below grew tomato fruits above—quite normal fruits, too—while potatoes developed underground. However, the potatoes were not all normal. They were small, twisted, scabby, and discolored.

On the other hand, the plant which was potato above and tomato below produced neither tomatoes nor potatoes. It is true that there were some strange growths on the potato plant above ground, but they were not potatoes, nor were they tomatoes.

In order to explain this surprising development, it is necessary to refer to the method of growth in plants.

The roots of a plant take up moisture containing certain minerals which the plant needs. This moisture is sent up through the stem to the leaves. The leaves combine the moisture and its minerals with carbon dioxide which the leaves themselves take out of the air. The chlorophyl in the leaf brings about the chemical change, for it is only chlorophyl which can take the power from the sun's rays to start the chemical laboratory in its production of food for the plant.

The food is carried to all parts of the plant, including the roots. And it is only on this food that any part of the plant can thrive.

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It is easy to understand that the food must be different in different kinds of plants, for the result of the use of the food is quite varied. Therefore, it would seem necessary for potato roots to have the food manufactured by potato leaves in order to develop tubers.

In Mr. Burbank's test cases it is not surprising to find tomatoes on the plant which had tomato branches and leaves, because the tomatoes received the right kind of food. But the potato plant received tomato food, not potato food, and so the tubers were very much distorted.

On the other hand, the plant which had the potato for a top could not produce potatoes underground because the plant did not send out the necessary underground stems, even though it received potato food. In the same way, it would not be expected that the potato top should produce tomatoes, even though the root was a tomato root, because the root supplies only the raw material and not the digested food. It is the digested food which gives the plant its character.

Mr. Burbank did not find any difficulty in grafting the potato and tomato. It is true that they do not have woody stems like trees, but by using a long diagonal cut, he made successful grafts. He placed the two cut portions tightly together and, to hold them in place, tied twine tightly around them. This, of course, was done quickly;

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that is, the cuts were not exposed to the air for more than a few seconds. Within a few days, the two portions grew together and the twine could be removed.

The essential feature in grafting is to connect the two portions of plants in such a way that the growing parts come together. The growing parts quickly graft themselves to each other, and produce tissues which give strength to the unit.

When trees are grafted, a grafting wax is used to cover the wound until it heals. But when such plants as the tomato and potato are grafted, wax is not at all necessary. Following this same technique, people who are interested in the cactus have found it very easy to graft one kind of cactus on another. The two grow together very readily.

HALF A MILLION STRAWBERRIES—ONE GOOD

With 499,999 worthless plants as the result of several years of work, how could anyone keep on? Most men would have quit—but not Luther Burbank. Ordinary folks would have weakened and offered one for sale which *nearly* met the standards—but not Luther Burbank.

His high standards would not be abandoned even though he never found a good strawberry. It was this firm adherence to these standards which made his good

reputation. He had determined when he was still a young man that he would keep his standards high—always!

There were 499,999 worthless ones, and then came a prize. It was the best strawberry in the world. John Burroughs, the famous naturalist, said it was. He was so enthusiastic that he wrote eastern seedsmen advising them to purchase this variety which had been named the *Patagonia* strawberry. Mr. Burbank had let him eat a handful of the new variety and he knew that it would be enjoyed by everyone who ate it.

The berries are borne on a plant which grows vigorously and is admirably adapted to commercial planting. Its foliage is dark green, thick, and thrifty. The fruit grows in clusters which stand up from the ground. This is an advantage in commercial growing, because it prevents the berries from being splashed with mud during rainstorms. The fruit is no larger than some other varieties, but it is firm in texture, a bright crimson in color, and it has a yellow flesh which sets it apart from all others whose flesh is white.

Furthermore, the *Patagonia* bears fruit throughout the summer. It is called "ever-bearing." Mr. Burbank thought that this ever-bearing quality was brought to it by one of its parents which came from Chile. Chile, being in the southern hemisphere, has its growing season during our winter.

When this plant was brought to the northern hemisphere where the seasons are reversed, it seemed to be confused, and so continued to bloom and produce fruit throughout all of the months that were warm enough. This same characteristic had developed in apples which Mr. Burbank brought from New Zealand and in rhubarb which also came from the southern hemisphere. Whether this is the true cause or not is difficult to say. At any rate, it is an interesting speculation.

The strawberry has a wide distribution throughout the world. Some varieties grow in Patagonia, at the southern end of South America. Some grow in Alaska. Some grow in Norway where the seasons are very short and the winters very cold. It was quite natural that Mr. Burbank should get varieties of strawberries from these far-away places and combine them with others.

One of the American varieties used in his work was a plant which he had grown as a boy in Massachusetts. He developed a white strawberry from it, but this variety was not as productive as he felt it should be, so it was not introduced.

In addition to strawberries, he grew blueberries, cranberries, squaw berries, buffalo berries, balloon berries, and a number of others. Out of these experiments, only two balloon berries were introduced.

It is important to record these failures because they

are representative of many, many more which have not been mentioned, and they indicate the difficulties which he encountered. However, lack of results did not in the least discourage him. While he was experiencing many failures, he was having a few successes, and these successes were profitable enough to support him in his work, and they gave him enough encouragement to keep him working toward his chosen goal.

Failures often make strong men. Wise men are never afraid of failures. Usually, they do not call the lack of results failures, but *interesting steps* toward success—steps which must be taken before the goal can be reached.

13. THE BATTLE OF THE FLOWERS



W ARLIKE IN NAME, THE GLADIOLUS is so called because its leaves suggest the *gladius*, the sword of the Roman soldiers. Luther Burbank was very interested in this flower.

This was the flower which, when grown in the Burbank testing ground, had to be defended with guns. Its enemies were the pocket gophers who helped themselves to gladiolus bulbs growing on Mr. Burbank's Sebastopol farm. He was progressing nicely with the gladiolus when the gophers moved in. They work underground, and it was a long time before the damage they were doing was discovered.

The pocket gopher is seldom seen on the surface. It

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digs long tunnels, pushing the dirt out through openings here and there, but staying well protected beneath it. The tunnels are seldom large enough to enable the little animal to turn around, but the pocket gopher can run backward as easily as forward. It has a sensitive tail which feels the way when the gopher runs backward.

It was the appetite of this voracious little animal which caused the destruction of not less than ten thousand dollars' worth of bulbs at Sebastopol. Ordinarily, a pocket gopher eats the roots of trees, grasses, and grains. But the new kinds of gladiolus bulbs which it found in Mr. Burbank's testing lot seemed to please it so much that it moved in with all its relations and systematically proceeded down one row after another, devouring bulbs as it went.

There were great numbers of these animals, and so tremendous was the damage that Mr. Burbank had to give up his experiments with the gladiolus until he could get rid of the pocket gophers. This was not so easy. He tried poison, and gas, and traps. But none seemed to be effective.

He finally discovered an automatic gun which shot the gophers underground. It was called a "gopher gun," and was so placed that the gopher would touch the trigger which discharged a load of powder. These gopher

guns killed thirty-five or forty rodents every day, and eventually, the gladiolus bulb eaters were exterminated.

Mr. Burbank had begun his experiments with the gladiolus in 1882. Most of the kinds then available were hybrids which had been created in Europe. The gladiolus, of course, reproduces its kind only by bulbs; when seeds are planted, new varieties are secured.

This beautiful flower originally came from South Africa, and Mr. Burbank early secured bulbs from its native home. These he crossed with the European varieties. At first, the results of his work with the gladiolus were very disappointing. The blossoms faded quickly in the warm California sun, sometimes within an hour; and the whole plant gave indication of not being thrifty. For that reason, his first efforts were to get stronger plants and blossoms which would withstand the sun's rays. He also selected for a more uniform arrangement of petals. The flowers of the early kinds were not at all symmetrical, and not so beautiful as those we have today. It was a long time before he had new varieties which were pleasing to him.

The first one introduced was named *California*. The blossom grew on a hardy plant, and had many extra petals, but the most important new feature in the *California* gladiolus was its great profusion of blossoms. They grew all around the flower stalk, almost as the

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blossoms of a hyacinth grow. However, the *California gladiolus* never reached the general public; it was sold to an eastern dealer, who, through some carelessness, lost the entire lot of bulbs.

As soon as Luther Burbank had hardiness bred into his hybrids, he began to select for flower arrangement on the stalks. About the time he was beginning to have good results, the pocket gophers moved in. His fight against these rodents lasted for several years. But after he felt that he had eliminated the danger from underground attack, he began another series of experiments.

He developed some new varieties which had two rows of flowers on the stem instead of one. Some had four rows. A few had their flowers arranged spirally around the flower stalks. At the same time, he enlarged the size of the bloom and increased the quality and beauty of the petals. Among all these hybrids he had one variety of which he was very fond. In it two flowers seemed to be merged into one in such a way that there were twelve petals instead of six.

It is not easy to explain just how Mr. Burbank could successfully anticipate a certain tendency in flowers. His ability to forecast was, of course, based upon many years of experience and careful observation. It must be remembered that he studied each new plant systematically from the time the first leaves showed above the ground until

he reached a decision as to whether it was to be destroyed or retained. After making millions of observations of this sort, he naturally developed a habit of predicting what kind of flower would be borne on a certain type of stem.

As an illustration of the practical nature of this forecasting ability, he learned that when two light-colored varieties were crossed, it is very unlikely that a blossom of a desirable color would result. Usually, the new blossom is neither white nor yellow. A pale pink crossed with a white gladiolus is almost sure to produce a flower that is too pale to be called pink, yet too pink to be called white. The blossom is not at all attractive. In the same way, he learned what to expect from other combinations.

While new varieties of gladioli were usually produced by planting the seeds of any gladiolus plant, he made headway faster by selecting the parents and working toward a definite end. If he had merely planted any seeds which came into his possession, he would have depended entirely upon chance for results. But by selecting the parents, making his own crosses, and working toward a definite end, he was able to create varieties which were far more prolific and much more beautiful than any that had been developed in Europe.

To look at the blossoms which appeared on his acre of new varieties was to feel that some remarkable artist had

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designed the form and color of the blossoms, for many of them were of unbelievable beauty. Indeed, it *was* an artist who designed them—a celestial artist, for, although Mr. Burbank guided Nature toward the end he desired, it was Nature working in her intricate ways which brought about the new beauty of form and color.

THE GIANTS HAD A SECRET

One of the flowers which fascinated Mr. Burbank when he came to California was the Amaryllis. The common Amaryllis growing in the West is pink. Within a few years after he began his work, he received bulbs of various types of Amaryllis from Chile, Peru, China, Mexico, and South Africa, and these bore flowers of many different shades.

As he looked at the blossoms of these various plants, he somehow felt that it would be possible to make giant blossoms as beautiful as those of the smaller sizes. He therefore set about to make crosses in every way that he could. But at first, his experiments were not a success. Seeds were not produced. There was evidently a secret which he had not unraveled, and this he often referred to as the "secret of the giants."

Finally, he discovered that the pollen is borne by the Amaryllis flower several days before the pistil is ready to receive it. This is apparently a provision of Nature to

prevent the pollen from fertilizing the pistil of the same flower. After the petals have started to wilt, the pistil ripens, and the end bursts open, providing three sticky surfaces on which pollen may be received from some other blossom which is just shedding its pollen.

After he learned the "secret of the giants," he selected flowers bearing pollen and kept them in boxes until the three sticky surfaces on other blossoms were ready. Then his crossing resulted in seeds, the seeds were planted, and new varieties came forth.

As was his common experience, the first ones appeared to have no special value. But again this did not discourage him and he made crosses between these new kinds. Although the second generation was not much better than the first, he continued to cross until, in the tenth generation from the original, giant blossoms were produced. Some of them measured ten inches across. Some had more petals than varieties previously known. The colors varied from white, striped with red, to a clear fiery scarlet.

The *Amaryllis* multiplies by offshoots from the bulb. In other words, additional bulbs grow from the original one each year. These will then produce a plant which has flowers like the parent. This is the only way that a new *Amaryllis* can be multiplied; the seeds will not reproduce true.

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Most of the species with which Mr. Burbank started to create his "giants" would produce four or five new bulbs in a year, but the new varieties had as many as fifty in a year! Consequently, these new kinds multiplied much faster. This was a great advantage to a seedsman who bought a *Burbank Giant Amaryllis* to introduce. Instead of having five bulbs to sell, he might have fifty.

Another characteristic of prolificness appeared in the new kinds. Instead of producing one stalk from a bulb, four or five stalks grew. Some had as many as twelve flowers on one stem!

Also, the bulbs of these new kinds were generally larger. A large stalk grows from a large bulb, and a large blossom needs a large stalk. The new plants were giants from head to foot, so to speak—or, more accurately, from bulb to blossom.

After Mr. Burbank had a large collection of these giants in his garden, as well as blossoming plants of the many foreign *Amaryllis*, visiting horticulturists, seedsmen, and scientists stated that his was the best collection of *Amaryllis* in the world. It included the greatest diversity of forms, and the most unusual individual plants.

As a matter of fact, his garden has never been duplicated anywhere. It was not a formal garden in any sense of the word; he did not plan his grounds to be a show

place. But the plants in his experiments were so unusual and so attractive that people who came to visit him were fascinated by what they saw.

When the Amaryllis experiments were under way, he had many new varieties to sell each year. In August, 1909, he issued a catalog entitled, "A Brief Descriptive List of the New Burbank Giant Amaryllis." In this catalog, he described one hundred and thirty-six new kinds. These were offered at prices ranging from \$5 up to \$350 per variety. The purchase price included all of the bulbs of the new variety in existence. He kept none for himself; and he had sold none previously. So the purchaser had the exclusive right to introduce the new Amaryllis.

One of his new hybrids, called *Martinique*, was described in this catalog as follows:

"A remarkable new hybrid of the *Sprekelia formosissima* or Jacobean lily with the Amaryllis (*hippeastrum vittata*). One of the most unique hybrids which has been produced among the bulbous plants. The flowers are fiery crimson like those of the Jacobean lily but very much larger, being nine inches in diameter. But, even more remarkable, are the long curious twisted petals which give the flowers a strange appearance which is not found anywhere else among the Amaryllidæ.

"Leaves are pale green, upright, strap shaped, one inch wide, eighteen to twenty inches long. The flowers are

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fiery crimson on slender stems one and one-half to two feet long—usually two flowers to each stem.

“I have now produced 58 large bulbs and 57 small ones of this new hybrid. Price for the whole stock without reserve, \$350.”

As compared to this high-priced variety, he described a kind which he was willing to sell for \$5 as follows:

“Clear red, large light-green foliage, no stripes on flower, but shadings of crimson and white toward the base of each petal. Three bulbs, \$5.”

A variety which he offered at \$240 was described as follows:

“Early prodigious multiplier. Pure deep scarlet with shades of crimson, no stripes. Light green foliage. Two to four flowers on each stalk. Flowers eight inches across. Petals three inches wide. Height about three feet. 120 bulbs, \$240.”

The total price he asked for the 136 varieties described in this catalog was \$5,504. Most of them had no names. He left the naming to the purchaser.

These new kinds were remarkable as cut flowers, some of them remaining in perfect condition for ten or twelve days.

The giants had a secret. Mr. Burbank learned it, and produced over \$5,000 worth of a giant species of *Amaryllis*.

GIANTS AND DWARFS APPEAR

"You've been reading *Alice in Wonderland*," said a seedsman to his associate when he was told that giants were seen growing side by side with dwarfs in the experimental grounds at Sebastopol.

"A family produces either large plants or small plants—never both," he explained.

This illustrates how difficult it was for those who did not visit Mr. Burbank's grounds to believe what was occurring there. While he was experimenting to get a fragrant calla, he developed varieties with giant blossoms ten inches across; and he developed others with blossoms only two inches wide. Both of them were attractive; one because of its huge size, the other because of its daintiness.

The giant flowers were borne on stems six feet or more in height. The leaves were also huge in size. The dwarf grew beside the giant and had short stems, small leaves, and dainty white blossoms. There were all sorts of colors in this field of strange new varieties. Many were yellow. One, an offspring of the giant calla, produced a blossom which was almost crimson; even the flower stalk was red. One was green where most callas are white.

The astonishing variations which were so easily produced in Mr. Burbank's garden demonstrated that the

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calla is an interesting plant with which to experiment. The calla, of course, reproduces from bulbs. All that is necessary to get new kinds is to plant the seed; every calla seed will produce a new variety whether a special cross has been made or not.

As a result of his experiments, Mr. Burbank introduced five callas with the following names: *Dwarf*, *Everblooming*, *Fragrance*, *Giant*, *One Best*, and *Snowflake*.

He also worked with cannas, having at one time as many as half a million new seedlings growing on his Sebastopol place. From these seedlings he introduced two new species, one named *Burbank*, and the other *Tarrytown*. The *Tarrytown* was a beautiful brilliant crimson flower, which received the Grand Gold Medal at the Pan-American Exposition at Buffalo, as the best canna exhibited—and there were large numbers in competition. As was the case with most of his new flowers, the *Tarrytown* was unusually prolific. The original had nine stems growing out from the main stalk.

The petals of most cannas remain on the flower stalk after they have faded. Mr. Burbank thought this an undesirable characteristic, and selected for a neater flower following the blooming period. The petals of the *Tarrytown* drop to the ground as soon as the blossoms fade; thus, the flower stalks always look neat.

This famous *Tarrytown* canna was produced by cross-

ing a native canna secured from the Florida Everglades, where it is known scientifically as *Canna flaccida*, with the cultivated variety known as *Crozy* canna. The Florida plant produced large, lemon-yellow flowers. The flowers of the *Crozy* varied in color. Probably these two species had never been joined before, and their development had been along lines so different that, when the pollen was taken from one to the other, the resulting hybrids proved to be most useful in Mr. Burbank's work.

This crossing, however, was not so easy. The cannas are pollinized quite largely by hummingbirds. And when two species as distinct as those Mr. Burbank used are brought together, difficulties often arise when artificial pollinizing is attempted. As a matter of fact, Mr. Burbank worked for eight years before he succeeded in making the crosses.

Before Luther Burbank's time, it had been the plan of those who grew the canna from seed to file off a part of the hard thick shell of the seed so that moisture might be absorbed. If this was not done, the seed would not germinate for a long time. This technique did not appeal to Mr. Burbank because he wanted to work with a large number of seeds, so he devised a method for mass production.

It was this: He soaked the seeds in a solution of copper sulphate. He then placed them in rather coarse gravel

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which had been sterilized by being boiled. He poured water through the gravel at frequent intervals. This helped to prevent fungus growth; fungus damage would have been most likely if the seeds had been planted in ordinary soil.

Even with this preparation, it required several months for the seeds to germinate. He discovered that, while these seeds would germinate at a lower temperature, he got better results if the temperature was kept between 60 and 70. The temperature could be controlled in his greenhouse, where most of his seeds were started in flats.

The seedlings were transplanted shortly after they showed themselves above the ground, and in the month of May, he again transplanted them into the garden. There cultivation was the same as for other seeds.

A large number of the seedlings were absolutely worthless, but persistence bore results. The *Burbank* and the *Tarrytown* cannas justified the patience and hard work he had given them.

14. NUTS GROWN WHILE YOU WAIT



IN MASSACHUSETTS, AS A BOY, YOUNG Luther Burbank made annual trips for the gathering of nuts. One of his favorites was the chestnut. He was interested in learning about the growth of the tree, and the possibilities of improving it.

In California, he was able to carry on work of this kind on a larger scale. Twenty-five chestnuts were in his first shipment of seeds and plants from Japan, in 1884. These were planted, and trees which grew from them proved most valuable in his experiments.

Hybrids were made by crossing these first seedlings with other varieties from Europe, China, and America. Eventually, there were some hybrids with habits so strange that they seemed to be new races of plants.

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The most astonishing characteristic was the ability to produce full-sized chestnuts in six months from the planting of the seed! These were truly infant prodigies; no nut tree had ever done such a thing before, so far as anyone knew. Most of the nut trees do not produce flowers or nuts until they are ten years old or more. Even then, the crop is often small until the tree is twenty years old.

But now Nature has yielded to man's impatience and given the food desired from the chestnut tree in such a short time that the crop might almost be compared to a crop of grain or vegetables.

To be sure, not all of the seedlings bore nuts so early in their lives, but many of them bore nuts within eighteen months from the planting of the seed. Each tree which grew from a seed was of a new variety, although there were important similarities. Best of all, most of the nuts produced on these hybrids were good to use as food.

The trees were often not more than twelve or eighteen inches tall when they began to bear, and it was hard to believe that they were really trees. The branches were covered rather thickly with large green spiny shells and some of them had from six to nine nuts in each shell, whereas most chestnuts have only two or three.

Mr. Burbank was delighted with the quick response of the chestnut, for this gave him an opportunity to make

many more generations of hybrids within a few years than would have been possible if the trees had not come into bearing until they were older.

Some of these hybrids were so eager to reproduce themselves that they bore continuously, some nuts ripening almost every month of the year. Others bore nuts two inches in diameter and weighing about an ounce. However, these large nuts were usually not so good in flavor as those of a medium size.

As a result of this work, Mr. Burbank introduced three varieties of chestnuts: one known as the *Hale*; one as the *Coe*; and one as the *McFarland*. These were named for the men to whom they were sold and these men took the responsibility of introducing them to orchardists. This was the beginning of chestnut orcharding.

In Massachusetts young Luther Burbank had also gathered hickory nuts, from the hardy shagbark hickory which grows in the North. In California, he came to believe that important results might be obtained by crossing the hickory nut and the pecan, which are closely related. The pecan, of course, is not hardy and lives in the South, mostly in the Gulf states. Frost can kill pecan trees, and cool nights will prevent the nuts from ripening.

The pecan was the only native nut tree which had been developed as an orchard tree at that time. Its thin shell

and its delightful flavor made it popular. The pecan orchard tree is made by budding or grafting, and there are many profitable pecan orchards in the southern states.

By crossing with the hickory, Mr. Burbank hoped to increase the hardiness of the pecan, or to produce a new nut combining hardiness with delectable taste. This he was not able to do, however, because the shagbark hickory did not thrive at Santa Rosa or Sebastopol. At one time, he received specimens of nuts which he believed were hybrids of the shagbark and the pecan. But the seedlings which grew from these were destroyed by the pocket gophers and he was never able to complete the tests with them.

The difficulty in working with the hickory nut is that it does not bear fruit until it is ten or twelve years old. In other words, it requires ten or twelve years to produce one generation. This makes the work of the plant improver very slow, if he is going to create many generations of hybrids.

Mr. Burbank discovered that one of the reasons why the hickory tree (and pecan) grows so slowly is that it develops a very extensive root system. In the course of his work, he determined that about ninety-nine per cent of the growth during the first year is underground. Some pecan seedlings which he grew had roots from four to

six feet long and an inch in diameter in the first year's growth, whereas, above the ground, the young tree was only about an inch high.

There are doubtless two steps necessary in the improvement of the hickory nut. The first step would be to produce hybrids which would come into fruiting early in their lives, like the Burbank chestnut; the second step would be to make improvements in other qualities. Without early fruiting, the experiment would extend over so many years that no one man would be likely to complete the job.

While Mr. Burbank made some effort to improve the hickory nut, he left the main part of the job to someone else, and the success which growers have had with the pecan points to the value of developing varieties to be grown farther north.

Mr. Burbank thought that the pecan might also be crossed with the walnut and the butternut, for they, too, are closely related. He never tried this experiment, however.

With walnuts, Luther Burbank's experiments were as amazingly rewarded as his work with chestnuts. No wonder he called one variety the *Royal* walnut; it produced nuts so valuable and in such great quantities that one year's crop from one tree was sold for a thousand dollars.

When the *Royal* walnut was developed, many men in California were planting orchards of English walnuts. It was discovered that the seeds of the *Royal* walnut produced root stocks on which the English walnut thrived; the English walnut trees are much less subject to disease when grafted on the *Royal* root stock. Furthermore, the English walnut produced larger crops when it had the *Royal* walnut as the food-gathering part of the tree.

As a boy, Luther Burbank had gathered black walnuts in the woods on his father's farm. When he went to California, he discovered that the English walnut and the black walnut are related to each other. He also found a black walnut growing in California which was called the *California black walnut*. When he crossed it with the Eastern black walnut, he got the valuable new variety which he called *Royal*.

He also crossed the California black walnut and the English walnut and obtained other interesting hybrids. Some of these grew at a tremendous rate. Furthermore, they kept up this rapid growth year after year. One of them grew to be sixty feet tall, its branches shading sixty feet of ground, with a trunk two feet in diameter, when the tree was only sixteen years old. This is unheard-of growth for a walnut.

Visitors remarked about the beauty of the tree, and Mr. Burbank told them that it was only half as old as the

English walnut trees which were growing on the opposite side of the street and which were only eight inches in diameter at thirty-two years of age.

This remarkable new walnut was introduced as the *Paradox*. When the seeds of the *Paradox* are planted, some will develop into very rapidly growing trees, similar to the *Paradox*, while others grow like dwarfs. The dwarf may be only six inches high, when the giant beside it is twenty feet high!

The branches of the *Paradox* had a tendency to droop, which added to the beauty of the tree. The leaves were long and, instead of having the strong odor of the black walnut, they had a fragrance resembling an apple.

Although the *Paradox* did not produce a large crop of nuts, it was valuable for the beautiful dark lumber which could be sawed from its trunk. It was comparable to the black walnut tree of the East in this respect, and inasmuch as it grew more rapidly than other lumber trees, and at the same time produced the very best of cabinet wood, the *Paradox* was destined to be of very definite value as a lumber producer.

It was first thought that, because of its rapid growth, the *Paradox* would produce a soft rather than a hard wood. However, compared with the wood of the eastern black walnut, it was found to be almost as hard.

Mr. Burbank was a pioneer in the improvement of

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forest trees. Most people had considered the forest trees as more or less stable; little thought had been given to improving them. But this attitude changed when the *Paradox* demonstrated that a tree can grow into a marketable crop in sixteen years.

Today, the importance of growing new forests as we grow any other farm crop, is widely recognized. It is true that most of the forest trees, such as the white pine, require forty to sixty years to produce a crop of lumber; but there is no reason why this time cannot be greatly shortened by developing faster-growing varieties. The Burbank experiments, by producing the chestnut prodigies and the *Paradox* walnut, have proved that it can be done.

15. FAMILIAR FRUITS TRY NEW TRICKS



ALTHOUGH NO ONE BELIEVED that the tender peach could be made to grow where temperatures descended to fourteen below, in his characteristic manner Mr. Burbank set about to increase the hardiness of this particular fruit, so that it might be possible.

The idea of breeding trees which would be immune to disease and insects was considered to be the fiction of a dreamer.

This skepticism made no difference to the plant magician of Santa Rosa. He started to cross peaches and nectarines in 1895, with the hope that he might produce some new kinds which would be immune to common pests and which would withstand cold winters. He

wished to widen the territory in which these delicious fruits might be grown.

The variety called *Muir* was known to be resistant to curly leaf, a disease which was destructive in many peach orchards. So he decided to cross this with the nectarine, which is a smooth-skinned peach with white flesh. It was the sixth generation before he had a new variety of peach which he thought was worthy of introduction. It was named *Opulent*.

The tree was vigorous and prolific. It started to bear fruit when it was still quite young. The fruit had a white skin with numerous dots and shades of both light and dark crimson. The flesh was a pale lemon yellow, and the flavor was delicious. Many declared, when they tasted it, that it was the most delicious of all peaches.

The new tree was resistant to the curly leaf disease, and tests made as far north as Canada showed that it would endure a temperature as low as forty degrees below zero. In seasons following this low temperature, the *Opulent* trees bore full crops of peaches although other peach trees were killed by the severe cold.

While the *Opulent* had many unusual characters which were of value to the orchardist, it lacked shipping ability. It could be used and sold locally, but it would not arrive in perfect condition when shipped entirely across the country.

Mr. Burbank later introduced two other varieties, one called the *Leader*, the other called *National*. But he did not stop there. He kept on with his experiments, and four additional varieties may now be purchased from nurserymen with the names: *July Elberta*, *Burbank's Giant*, *July Gold*, and *Burbank's Giant Freestone*.

The *July Elberta* is referred to as "Burbank's Masterpiece." It ripens twenty days before *Elberta*. It bears when only two years old. It is hardy, doing well in Canada. The flesh is firm, juicy, and delicious. Shippers like it because it arrives at distant markets in perfect condition. It is ideal for commercial orchards.

Burbank's Giant is a huge yellow freestone peach, often measuring three and a half inches, and sometimes four inches, in diameter. The seed is very small. The tree begins to bear in its second year, and has thrived after a winter of fourteen degrees below zero. But it is best suited for the home orchard, for it does not ship as well as others.

The *July Gold* is a big clear orange-yellow freestone peach which ripens earlier than the *July Elberta*. It is a hardy young bearer, and is said to be the best early yellow freestone. Red and gold in color, and a splendid shipper, it is attractive on the market after being shipped a long distance. It ripens twenty days earlier than its parent, the *Elberta*, and one grower reports that, because of the

earliness and splendid quality, he gets from \$3.50 to \$4.20 a bushel. His orchard is in a section where the temperature sometimes goes to twenty-four degrees below zero.

Burbank's Giant Freestone is described as of huge size, of great beauty, and of delicious quality. Its flesh is a clear golden yellow, and the tree bears when very young and it is extra hardy.

Mr. Burbank also introduced two nectarines as the result of this work. One is called *Flaming Gold*. The other is sold as *Burbank's Blood Nectarine*.

The *Flaming Gold* is a "wine red blushed over vivid gold." It has a "rich golden orange flesh of honey sweetness and champagne sprightliness." It is a freestone and the stone is small. The flesh is firm, which makes it a good shipper. It ripens a week before Elberta peaches and withstands temperatures as low as fourteen degrees below zero, while its growers report it to be very resistant to disease and rot.

Burbank's Blood Nectarine is so called because of its blood-red flesh. It is the only one ever developed with this color. Reported by growers to be free from rot and cracking, it is recommended for local use only and is especially good for canning.

The almond is a close relative of the peach and Mr. Burbank made some interesting crosses between the

purple-leaved peach and the Languedoc almond. The two fruits crossed rather readily, but most of the seedlings had leaves like the peach. Those which resembled the almond grew more rapidly than those which resembled the peach.

In further experiments, he used what is known as the "double flowering peach" from China and Japan. The blossoms are about an inch and a quarter in diameter; some are white, some pink, and some a deep crimson. They are double flowers and look like roses. They are produced in such profusion that the trees are splendid ornamental plants. However, they are subject to mildew and curly leaf in this country.

The fruit of these trees is of no value. The stone is very large and the flesh does not have a good taste. By crossing these with some of the standard varieties of peaches, Mr. Burbank was able to get some flowering trees which bore better fruits; however, these fruits are more useful for cooking than for eating raw.

He continued to work with crosses between the almond and the peach in the hope that he might get a fruit which would be desirable, and a seed which would be as good food as the seed of the almond. While he made progress toward this end, he did not reach his objective, at least not to his own satisfaction. There were some who thought

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that he had what he wanted, but his standards were higher than theirs and he did not introduce the variety.

He also crossed the peach and the plum, using a Japanese plum and also a plum called the Chickasaw—an American variety. Perhaps if he could have continued these experiments long enough, he would have produced a stoneless peach, as he had produced a stoneless plum.

These experiments show that it is entirely possible to work toward a definite objective and reach it. He was able to produce varieties of peaches which will withstand cold winters and which will be immune to common peach pests. He had placed great emphasis upon freedom from mildew and curly leaf, and his two peach varieties, *Leader* and *National*, proved to be unusually free from these pests.

It is clear that his early determination to make hardiness one of his chief principles was justified, for he greatly extended the areas in which desirable fruits can be grown. This accomplishment alone was of sufficient importance to establish Luther Burbank as a world leader in horticulture.

A PEAR TREE RESISTS PESTS

If fruit growers never had to fight tree pests, their returns would be much greater. This idea was always

very much in Mr. Burbank's mind, and he continually sought for trees which the pests would not attack. When he began his work with the pear, he determined to develop a tree which would be immune to injury by insects or diseases.

He made importations of a number of plants and seeds from Japan in 1884; and in this shipment there were twenty pounds of pear seeds. Then, in 1890, he imported a large quantity of the seeds of the sand pear from China.

Seedlings of both these oriental kinds were most interesting. Some were fast growers; some grew very slowly. Some had very good fruits; the fruits of others were of no value. Some died after a few years of growth; others seemed to be thrifty.

He used the pears that were commonly grown in America as a source of pollen for crossing these oriental species, and obtained many hybrids, some of which produced fruit of large size and good quality. But most important, one of them proved to be immune to blight and other pests which infest most pear trees.

He worked with seedlings and hybrids of the pear, however, for nearly twenty-five years before he finally introduced one in 1911 with the name *Test*. This new pear had produced two or three times as much fruit as any other variety, and the fruit was larger than the

Bartlett pear. It was a variety liked by the orchardist for its immunity to disease and insects, and the good quality of the fruit.

Inasmuch as the pear, the apple, and the quince are closely related, Mr. Burbank tried crossing them. The three fruits belong to the rose family, but each is classified in a separate genus. He made a pear-apple hybrid, an apple-quince hybrid, and a pear-quince hybrid.

The seedlings grew well, but none of them ever blossomed. Nevertheless, Mr. Burbank did not believe that it was impossible to cross the fruits successfully. He concluded that he had not used the right varieties for making the cross, or else had the wrong individuals. From his experience, he knew that some individual plants will resist hybridization, while others will hybridize. For that reason, he was never willing to say it was impossible to cross any two plants.

Since a pear tree that produces no fruit is of very little value, he promptly consigned these hybrids to his bonfire. The crosses simply represented one of the many interesting experiments he tried without success.

When the seedlings resulting from the hybridization of the apple and the pear would not bloom while growing on their own roots, he tried grafting them onto an old apple tree. There they grew for a while, but did not

bear any blossoms or fruit. Approximately the same results were had with the hybrids of the pear and the quince.

When it is realized that Luther Burbank introduced two hundred and fifty or more new varieties of about fifty different classes of plants, it might be thought that everything he attempted was a success. But that is not true. He tried many more experiments which failed than those which succeeded. It was his persistence in spite of failure which made him the world's leading horticulturist.

It must be admitted that while Mr. Burbank worked a great deal with pears, he did not produce enough new varieties to justify the great amount of work. The same conclusion might be reached with respect to his experiments with apples. He introduced only two varieties, the *Gold Ridge* and the *Winterstein*. However, he grew thousands of seedlings and thousands of hybrids.

He estimated that he grew more than fifty thousand seedling apples from the time he began in 1886. In addition to the two he introduced, he had about ten others which were better in certain respects than existing kinds.

While he used about an acre of plums as host trees for his plum experiments, he used only one apple tree. The apple tree grows very much larger than the plum and he was able to grow as many as five hundred and twenty-six varieties on this one tree at a time. Instead of walking

through row after row as he had to do when selecting new plums, all that was necessary with the apple was to climb a stepladder and examine the fruit on the various cions covering the tree.

Those who visited his Sebastopol place were astonished at the appearance of this one apple tree which served as nursemaid to these five hundred and twenty-six varieties, yet to Luther Burbank it was simply a practical expedient to speed up his work without using too much land.

With the apple, as with the pear, he watched for varieties which would be immune to insects and disease. He made attempts to find varieties of pears which could be used as root stocks to give immunity to apple trees when grafted on these root stocks. The experiments, however, did not meet with success.

The *Northern Spy* apple is immune to the woolly aphis, and he tried to make use of root stocks grown from *Northern Spy* seeds in order to transmit this immunity. But for some reason the immunity was not transferred and this experiment failed.

He was finally able to cut twigs from the *Northern Spy* and root them in the ground, where they grew to sufficient size to be used as root stocks for other apple varieties.

During his experiments with apples, he imported various kinds from Australia and New Zealand. Some of

these would not send out any blossoms at all. Others continued to send out blossoms the year around.

He made additional crosses between the wild crab and a variety of apple called the Gravenstein, hoping to add the hardiness of the wild variety. The seedlings were interesting but produced no new variety worthy of introduction.

A QUINCE TREE WORKS OVERTIME

It is not easy to believe that a fruit tree can bear three crops per year, even in California. But under favorable conditions, the first quince which Mr. Burbank introduced, the *Van Deman*, produces three distinct crops each season.

The first crop is ready in September and is made up of huge fruits about five inches in diameter and weighing about twenty-five ounces each. The second crop is harvested in November, and is made up of fruits of smaller size, but of just as good flavor and texture as the first crop. The third crop is smaller and is gathered in December. These quinces are especially good for baking. They also may be dried and canned.

The *Van Deman* quince was awarded the Wilder Medal at the meeting of the American Pomological Society in Washington, D. C., in September, 1891. It was so admired by Professor H. E. Van Deman, who was

then chief of the Division of Pomology in the United States Department of Agriculture, that Mr. Burbank named it for him.

The exact parentage of the Van Deman quince is not easy to list, because Mr. Burbank made crosses and re-crosses of hybrids many times before he finally obtained a variety which he deemed worthy of introduction. He had used varieties in these experiments which were known as *Orange*, *Angus*, *Portugal*, *Rae's Mammoth*, *West's Mammoth*, and *Champion*. He estimated that he had tested about fifty thousand quince seedlings before he had one which was worthy.

The *Van Deman* is known for its productivity, its size, its globular shape, smooth skin, and attractive color. It has a spicy flavor, and a tender flesh and is remarkably hardy.

The second good quince which he introduced was a seedling from *Rae's Mammoth*. This variety had been crossed with the *Portugal*, and the new variety appeared in the third generation. It was first called the *Santa Rosa*, but was renamed *Childs'* quince, after it was sold to a nurseryman named Childs.

The tree bears large fruits and is very productive. The beautifully formed fruit is almost white or a pale yellow; its flesh is tender and of a delicious flavor, and the core is very small. Many people consider it equal to a good

apple for eating raw. This is an unusual quality for a quince, for quinces, before this time, had been known as cooking fruits only.

About fifteen years after Luther Burbank began his work with the quince, he produced a new variety which excelled all others in its delicious flavor. In fact, it had the flavor of the pineapple, and so was named the *Pineapple quince*. Its large and uniform fruit, of a pleasing light yellow color, is good when eaten raw; it cooks quickly, usually being perfectly tender in about four and a half minutes, and makes a delicious jelly with a strong pure pineapple flavor.

The *Pineapple quince* proved to be the first variety which could be shipped successfully from California to New York. A California orchardist shipped a quantity in twenty-pound plum crates in 1910. The first shipment sold for \$3.20 per crate—seventeen and one-half cents per pound!

Mr. Burbank carried on many other experiments with quinces. As a matter of fact, he began as early as 1884 to cross the oriental quinces with the American varieties. Those crosses never produced a tree which bore blossoms, although he grew thousands of seedlings. However, some of these oriental varieties proved to be beautiful flowering shrubs, and were introduced for decorative purposes. Thus the lowly quince, the Cinderella of fruits

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with no social standing, was transformed by the plant magician and took its place among the socially prominent apples and pears.

THE "PLUMCOT" ANSWERS ARGUMENTS

In general, Luther Burbank was not concerned with rules or classifications which man made, because all he wanted was new plants which would better serve mankind. He didn't care whether these were secured by following established rules or procedure already formulated, or whether they were secured in some new way. If they could be had, he wanted them.

He felt that, if he allowed himself to be held back by some of the rules, he would not be able to give very many new plants to the world. Certainly, we would not have had the *plumcot*, a new species of stone fruit combining the hardness of the plum and the delicious flavor and aroma of the apricot; for one of the rules quite generally believed was that: "New species cannot be created."

Scientists living before the time of Burbank, who classified living things into groups, had placed the stone fruits into a genus called "Prunus." A separate species name was given to the plum; another to the apricot; another to the cherry; and so on.

Experience up to that time seemed to indicate that

species are so distinct from each other that they cannot be combined. No one had been able to cross the pollen from one to the other. It was thought that it would not be at all possible for the pollen of the apricot to grow if it were placed on the pistil of the plum; and it would not be possible for the pollen of the plum to grow if it were placed on the pistil of the apricot.

Mr. Burbank knew this rule, but he had known rules to be unreliable in other cases; was this particular rule correct?

The apricot had always appealed to Mr. Burbank as a most deliciously flavored fruit, but there were many climates where it could not thrive. On the other hand, his work with plums had taught him that plum trees are the most hardy of all the *Prunus* genus. He had already worked with *Prunus triflora*, a Japanese plum; with *Prunus simonii*, a Chinese plum; with *Prunus domestica*, a European plum; and with several other species.

His first attempt to combine the delicious flavor of the apricot with the hardiness of the plum was a failure. The pollen would not grow on the other species, and it looked as if those who said it was impossible to cross plants of two distinct species might have been right.

However, Mr. Burbank kept on trying. In making the unusual crosses, his method was as simple as ever; he picked a blossom from an apricot tree and scattered the

pollen on plum blossoms. He also picked plum blossoms and scattered the pollen from them on the apricot's blossoms. If those who believed he was violating a law of Nature had been there, they might have tried to discourage him. If he had paid attention to the prohibitive rules of man, he would have told himself long before that Nature would not make such a cross.

But he knew from his own experience how often persistence had brought rewards; often, in his efforts to guide Nature in the direction of plant designs more useful to man, he had made thousands and thousands of crosses before he obtained a single mature seed. Finally, a few seeds were produced from a cross between one of his Japanese plums and the apricot.

As soon as he saw the new trees thrusting their leaves above the ground, he recognized a combination of the characters of plums and apricots in the bark, the leaves, and the terminal bud. And when he examined the roots, he saw even more astonishing manifestations. The apricot root is an entirely different color from that of the plum. The plum is usually a pale color, yellow or sometimes white, but the roots of the apricot are red. The first of his hybrid seedlings had dark red roots.

As he expected, a large proportion of the new seedlings showed undesirable characteristics. But, following the practice ~~he~~ used with plums in order to get fruit

more quickly, he grafted cions from the promising seedlings on old plum trees. In two or three years, he began to see fruit of this new species of *Prunus*.

The fruits were neither apricots nor plums. To be sure, they were somewhat the color of plums, although the color varied between the different seedlings. The flesh was firm like the plum, rather than soft like the apricot. But many of the stones were almost exactly like the apricot stones, while a few much resembled the peach. Most of the pits had a sharp projection along one edge, which is a characteristic of the apricot. When the fruits ripened and he made the taste test, he realized that he had fruits uniquely delicious.

After a period of years, he found that he had trees far more rugged than those of the apricot. He had, indeed, made a combination of the apricot and the plum, and it was appropriate to call the new fruit *plumcot*.

It was not often that Mr. Burbank exhibited his new fruits at fairs, but in 1901, he showed some of the new plumcots at the Pan-American Exposition held in Buffalo, New York. Not only did the exhibit attract big crowds of visitors, but a special gold medal was struck by the officers of the Exposition and given to Mr. Burbank. Of course, these new fruits had no classification at the Exposition and so no prizes were offered.

When a fruit so new as the plumcot is created, it

might be thought that the seeds would produce either a plum or an apricot when planted, but the seeds produced plumcots—never plums, and never apricots. This indicated the creation of a new species which perpetuated itself through its seeds.

One of the first of the new plumcots was sold to Don M. Rutland of Australia. This variety was named the *Rutland plumcot*, and Mr. Rutland introduced it into the southern hemisphere, including Africa. This same fruit was introduced into the northern hemisphere by George C. Roeding of Fresno, California.

Nurserymen still sell at least six Burbank plumcots with the following names: *Apex*, *Corona*, *Rutland*, *Triumph*, *Purple*, and *Orange*.

When Mr. Burbank crossed the apricot and the plum, he showed that the old rule was an error; either the fruits had not been properly classified, or he had proved that distinct species can be crossed. So it is not surprising that Mr. Burbank felt it unwise to try to set up general rules about Nature; he proved many times that Nature's possibilities are limitless.

He often said, with reference to the rules: "If men who are trying to determine the rules of Nature would look for positive rules, rather than negative ones, they might be more successful, and they might discover that their rules would be less often violated."

16. ROSES ON THREE-INCH BUSHES



NATURALLY, MR. BURBANK LOVED the rose, as everyone does. So he began work with it early in his career, selecting and crossbreeding in a way similar to his technique with other flowers. His first introduction was a bedding rose which was called the *Burbank*. It was awarded a gold medal as the best bedding rose at the St. Louis International Exposition in 1904.

One of the interesting things about the *Burbank rose* was that it was produced in somewhat the same way as the *Burbank potato*. That is, a seed pod was found on a *Hermosa* rose, which rarely bears seeds. However, the new rose did not come directly from the original seed

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as did the *Burbank potato*, which was ready for introduction as soon as it had produced tubers. It was necessary to cross the pollen from the seedling rose in order to get the one which was finally introduced.

As a matter of fact, it was crossing which produced the vigor and other unusual qualities of the *Burbank rose*. It has hardiness sufficient to enable it to be grown in southern Canada, and it was soon recognized as the hardiest of all ever-blooming roses. It continues to bloom throughout the entire season, with the result that probably no other rose produces as many individual flowers in a year as does the *Burbank*.

Perhaps the strangest characteristic of this new plant was that it began to bloom when the seedling was only two or three inches high! Such early flowering had never been heard of before.

Another important characteristic, which should be emphasized in order to make it clear that Mr. Burbank was always looking for plants which would be resistant to pests, is that the *Burbank* rose is immune to the attacks of mildew and rust.

Of course, he used exactly the same methods in producing a rose that would be resistant to these pests as he did in producing other plants which would avoid trouble for the grower. He watched the seedlings, and if any

seedling showed susceptibility to damage by any disease or insect, that seedling was immediately destroyed.

Fortunately for Luther Burbank's experiments, susceptibility to disease and insects is likely to become apparent almost the first year the seedling grows. If the new plant grows through three or four years of tests without being damaged by insects or disease, it is quite likely that its immunity has been established.

While the *Burbank* was a most beautiful rose, these other qualities need emphasis because it has been a temptation to some who have grown seedling roses of beautiful color quality to introduce them regardless of their susceptibility to disease and insects. In other words, it is a genuine temptation to judge a new flower entirely by the blossom, and to neglect the plant itself.

Perhaps it was because Mr. Burbank had been a practical gardener and nurseryman that he realized the importance of studying the plant as well as the product to be used by man. In order to maintain this policy of selecting only the hardiest, Mr. Burbank destroyed thousands of seedling roses whose blossoms gave great promise, but whose stems did not come up to the Burbank standard.

He could easily have introduced many thousands of new plants which the public never saw. Seedsmen would have bought many of them if he had given them the chance. But as a boy he set his standards high, and he was

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never tempted to vary them. The man who talked to him on the train as he was going to California stimulated him to put into words a policy which emphasized hardiness of plants as a characteristic which he would never neglect.

He also selected for keeping quality, and as a result he had some seedlings whose blossoms lasted twenty-five or thirty days when left on the bush, and fifteen or twenty days after being cut.

After learning of the great quantities of individual seedlings which Mr. Burbank grew in order to get one that was worthy of introduction, some people have referred to his methods as pure luck. He grew over 200,000 seedlings from the crimson rambler rose which had been crossed with other roses. This was not just to strike a *lucky* hybrid, but it was necessary to work with such numbers to help Nature eliminate the many which are of no value whatever.

The production of just the right hybrid cannot be perfectly controlled by man, but the selection *can* be controlled. And the variations can be brought about by cross-fertilization. Furthermore, selections for future hybridizing are made by man as steps toward the goal which he has set.

In several of Mr. Burbank's experiments, these steps were not only tedious and expensive, but discouraging. He might hybridize and select for twelve years in work-

ing toward a certain type of plant without getting very near to it.

It is clear that the making of a desirable new plant is not as exact a process as the turning of a plow round on a lathe. It might be said to be even more complicated than the making of an automobile. Automobile parts can be designed perfectly on a drawing board and can be executed on specially built machines with the knowledge that various parts will fit together. But in the making of a new plant, the drawing board design, which, by the way, is usually a mental design, cannot be converted into parts which fit together exactly. So, it was necessary to grow thousands, yes, hundreds of thousands, of rose seedlings in order to get eight which were introduced up to the year 1912.

This need not discourage amateur plant improvers, however. There are times when the first crossing does yield a better plant. It is true that it doesn't happen very often, but it does happen sometimes. For example, the *Burbank* potato was selected from only twenty-three seedlings. The *Burbank* plum was selected from twelve seedlings.

The real compensation for the amateur plant improver is to be found in the unexpected variations which always appear following every cross-pollination. Each seedling is

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sure to be different. Some of them will be strange and weird. But most crosses produce at least one specimen which stimulates the plant improver to keep on with the work, by pointing in the direction desired.

There were times when Mr. Burbank did not find even one seedling rose which seemed to be developing in the direction he wanted. But because he worked with so many different kinds of plants, this did not end his work. He was getting results with some other plants even though the rose hybrids were failures. He kept on and on, knowing that good results might show up in any generation.

Previous to Mr. Burbank's experiments, most growers had said that Nature would not produce a blue rose. But Mr. Burbank did produce a blue rose—or rather, nature produced it with his help.

Up to 1912, he introduced eight roses with the following names: *Burbank*, *All Blossoms*, *Coquito*, *Corona*, *Little Hermosa*, *Peachblow*, *Pet*, and *Santa Rosa*. One nursery catalog lists three other Burbank roses with the following names: *Copper Climber*, *Snowwhite Climber*, and *Golden Sunset*.

But strangest of all his roses was the *Burbank* whose blossoms began to open when the bush was no more than three inches high.

THE DAHLIA WAS A GOOD PUPIL

Mr. Burbank often spoke of the plants in his garden as pupils in a school. He would say that he was trying to teach this pupil to do one thing and that one to do something else. Some of them learned readily, some of them did not.

He regarded the dahlia as a very responsive pupil. It was very easy to produce new dahlias; and it was quite easy to produce just the kind he wanted.

Our dahlias originally came from Mexico and Central America. The Spaniards found them there many years ago when they conquered Mexico; and the bright red and yellow colors appealed to the conquistadors so much that they sent some of the tubers to Spain, where they became popular. As a matter of fact, experimenters with plants produced many new varieties before Mr. Burbank started his work.

Each seed that is produced on a dahlia will grow into a new variety. The only true reproduction of a certain type is brought about by separating the tubers and growing a plant from each one. It is not entirely necessary, therefore, to make crosses in order to get variation. But Mr. Burbank did make crosses, in order to work toward a definite goal.

One of the astonishing results he obtained was a dahlia

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with a pleasing fragrance. If a flower can be attractive in size and form and color, as the dahlia is, there should be no reason why it could not also be attractive in odor. So he made an effort to find one or more which had a pleasing scent.

After working for a long time, he finally created a dahlia with fragrance which reminded him of the magnolia, although the fragrance was quite faint. His next step was to cross this plant with others in the hope that more would be found with a pleasing scent.

As new hybrids were made, he selected for scent, as well as for other desirable characteristics. He saved the seeds of those which pleased him, crossed seedlings produced from those seeds with others, and kept on until finally he had the sweet-smelling dahlia which he named *Fragrant*.

As a matter of fact, he developed several sweet-smelling kinds. He sold three of these to a Chicago seed company and continued his crossing and selection with other characteristics in mind. Many of his new varieties had wider petals; some had overlapping petals; and there were petals of many different colors. One hybrid had a few petals of a solid color, with the rest striped. The dahlia was a brilliant pupil in the Santa Rosa plant school and it is a good plant for anyone who wishes to create new varieties.

LUTHER BURBANK

Mr. Burbank's experiments were largely with the single dahlia. Today many plant breeders have been able to get very large and beautiful double dahlias. A gardener not far from Sebastopol, California, has developed some new hybrids which measure eleven and twelve inches across. Bright yellow and bright red in color, they are gorgeous creations.

Huge dahlias may also be seen in other places along the Pacific Coast, as well as north of Boston on the Atlantic Coast. These giant varieties are being sold to many people in the United States, and large beautifully formed dahlia blossoms will soon be quite common.

The names of ten of Mr. Burbank's dahlias introduced previous to 1912, are as follows:

<i>Burbank</i>	<i>David Burpee</i>	<i>Fragrant</i>
<i>Giant Yellow</i>	<i>Golden West</i>	<i>Merigold</i>
<i>Lemon Yellow</i>	<i>Mountain</i>	<i>Sebastopol</i>
	<i>Unique Salmon</i>	

17. AN EARLY AMBITION REALIZED



DURING ALL THIS TIME, LUTHER Burbank did not forget his boyhood ambition to produce a new daisy which would be larger and whiter than any yet seen, "the most beautiful daisy in the world." When he went to California, he took some of the seeds of the wild daisy of Massachusetts along with him. He worked with them for many years before he finally had what he wanted—the flower he had dreamed of and described to his mother.

This flower was the result of work with four different kinds of daisies—all of them smaller, all less white than the final product which so many people today grow in their gardens.

To see with what Luther Burbank began to create the now world-famous daisy, it is necessary only to go into almost any cow pasture and gaze upon the tiny weeds which many farmers call "dog fennel" or oxeye daisy. They are weeds, without a doubt. Their flowers are very small. Their petals are short. The plants are leafy. However, the eye of Luther Burbank saw beauty in them, and a future.

To start his experiment, he was able to get seeds of a daisy from England which had a larger blossom, and grew on a larger plant. He placed the pollen from this European daisy on the pistils of the oxeye daisy, and he placed the pollen of the oxeye daisy on the European blossom.

He then secured seeds of a daisy from Germany and used pollen from the flowers which grew from these seeds to cross on the seedlings of the cross of the oxeye and the English daisy.

The plant which results from the crossing of two distinct plants is called a hybrid. The pollen from hybrids themselves almost always had to be placed on the blossoms of other hybrids before very good results were obtained. This applied to all of his experiments.

While the European daisies had larger blossoms than the American oxeye daisy, they were not so graceful in form and did not have so many blooms on each plant.

They were coarse and weedy in appearance. They had many large leaves on the flower stalk, which Mr. Burbank thought a detriment because the leaves were more prominent than the flowers.

The genus to which these various daisies belong is "chrysanthemum." Scientists group plants which are similar to each other into a genus; then they subdivide the genus into species; the species is further divided into varieties. Usually, when the name of a plant is given in scientific language, the genus, the species, and the variety names are written in order. The daisies with which Mr. Burbank was now working had no variety of names. The oxeye daisy of New England has the scientific name *Chrysanthemum leucanthemum*. The daisy which he got from England has the scientific name *Chrysanthemum maximum*. And the one he got from Germany has the name *Chrysanthemum lacustre*.

First, a cross was made between *Chrysanthemum maximum* and *Chrysanthemum leucanthemum*. The seeds which were thus produced grew into plants which bore flowers showing a marked improvement over either kind. They were larger in size. But all of them had a yellowish tinge. So, further improvement was attempted by crossing this hybrid with the German daisy *Chrysanthemum lacustre*.

It required five or six years to make these various

crosses and bring the flowers into bloom; but as a result, Luther Burbank had a new species of daisies, whose blossoms were larger and more beautiful and were produced in greater abundance than any others.

But the flowers still did not have that crystal white color which he so much desired. So he kept right on with his experiments, collecting seeds each year only from the very best plants and from those which he hoped would produce a white flower eventually.

Finally, he discovered a fourth daisy in Japan known as *Chrysanthemum nipponicum*. The important thing about this flower was that, while it was very, very small, its petals were extremely white.

The flowers which came from the seeds produced by the first crossing with the Japanese daisy were disappointing. But the next season, Mr. Burbank saw, among the thousands of blossoms produced by this combination of daisies, one plant which had blossoms which were large and which, most important of all, were whiter than all the rest. These blossoms were growing among thousands in a long hedge of hybrid daisies, but they stood out among the thousands of white blossoms as strongly as if they were a coal black.

He wondered if other people could see that this one plant's blossoms were so much whiter than the others, so he led his workmen and all his visitors, one at a time,

past the place where they were. But none of them could see one blossom that looked whiter than the others.

"If a flower is white," said one man, "you can't make it any whiter. The blossoms are all white, so far as I can see. They are all beautiful. You are a wonderful man, Mr. Burbank. You have created lovely flowers. I think you ought to introduce every one of them. Let the world benefit from what you have here. There is nowhere else that anyone could see flowers like these."

But when a woman artist from San Francisco was visiting his garden, and he led her to the hedge of large new hybrid daisies and asked her if she saw one plant with blossoms whiter than all the rest, she pointed to the plant which Mr. Burbank had seen for so many days.

"Yes," she said, "they are outstandingly different from all the other blossoms."

The artist had a sense of color values which corresponded to Mr. Burbank's sense. She could see what other visitors had not seen. This delighted him, and he felt that he was ready to introduce the new plant.

On two or three occasions, he had visited the vicinity of Mt. Shasta in northern California. Mt. Shasta is a most beautiful mountain, perpetually covered with snow.

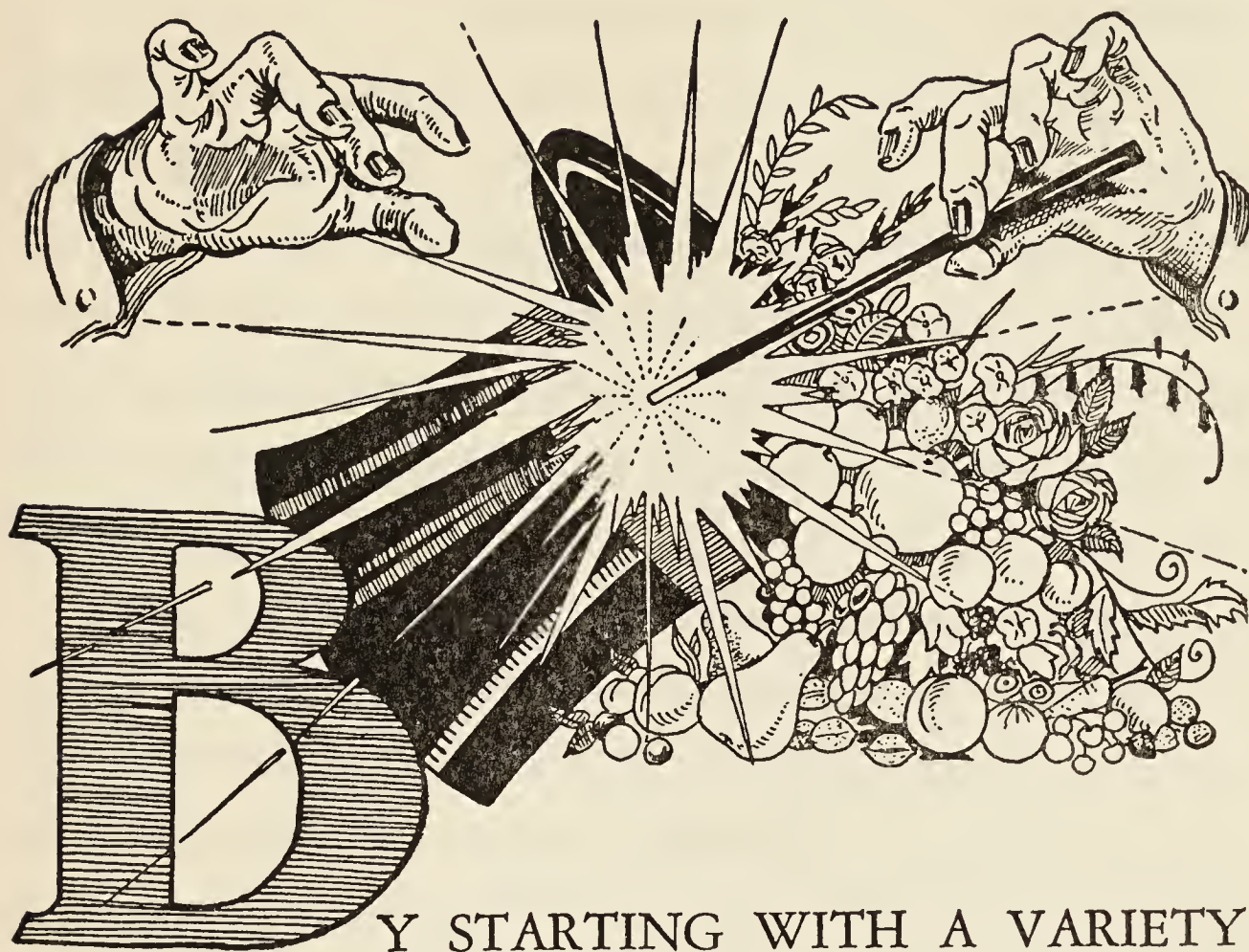
"I'll name the new daisy in honor of beautiful Mt. Shasta," he said to himself.

So he introduced the new flower as the *Shasta* daisy.

Thriving in all parts of the United States, it is today the pride of many a flower gardener. The huge graceful plants are prolific bearers of pure white blossoms. Many blossoms grow to be as large as four or five inches in diameter; indeed, some have been found that measured seven inches across. Their roots multiply, and the plants can be easily divided so that, in a short time, a great quantity of *Shasta* daisies may be obtained by division of the roots of the original plant.

When Mr. Burbank sold this *Shasta* daisy to a nurseryman for introduction, just as he did his other creations, he didn't get an unusually large sum. But he had never forgotten what Mr. Brown, the banker, told him on the day when they were returning from Marblehead, after he had sold his *Burbank* potato for \$150. Mr. Brown had talked of growing new plants to serve mankind, and Luther Burbank always sincerely worked for the benefit of mankind rather than for dollars and cents. It may well be that the *Shasta* daisy brought him more satisfaction than any other plant he created, because it gave pleasure to so many people.

18. MAGIC GOES AROUND THE WORLD



Y STARTING WITH A VARIETY of rhubarb which he secured from New Zealand and which was almost worthless there, Mr. Burbank was able to produce a new kind of pieplant which was later grown in the gardens of the King of Italy, the King of England, and the Emperor of Japan. It is small wonder that it appealed to these royal personages because it was so much larger, so much more beautiful in color, and so much more delicious than any rhubarb known that no one who saw it was able to resist it.

It was introduced with the name *Crimson Winter* Rhubarb. The "Crimson" was suggested by the red stalks; the name "Winter" was inserted because this strange new

plant continued to produce large stalks in abundance through the winter in mild climates.

When this rhubarb grew in New Zealand as an almost useless variety, with a stalk no bigger around than a lead pencil, it produced its crop during December and January, which are summer months in the southern hemisphere. Even though the seasons are reversed in California, it continued to produce during December and January. Also, the California spring stimulated its growth, and crops were harvested both summer and winter.

The New Zealand plant was crossed with some of the better varieties of rhubarb which Mr. Burbank had and, after working his customary magic with thousands of seedlings, he finally selected the largest and best and introduced it as the *Crimson Winter* Rhubarb. This new variety was so prolific and it brought such good prices during November, December and January when shipped to eastern markets that many growers in California reaped as much as \$1200 a year per acre by shipping it.

The *Crimson Winter* Rhubarb can be easily propagated, for the roots multiply very fast and, when they are cut into small portions, each portion will reproduce a new plant. Some stalks grow to be an inch or an inch and a half in diameter and four feet long, including the leaves.

This variety cannot be grown in the East because it

cannot withstand the severe winter. But it can be grown in a large part of California and, inasmuch as it has the necessary shipping quality, it can be sold in the eastern markets.

The Emperor of Japan and the King of Italy received roots direct from Mr. Burbank. These were planted in the royal gardens and they multiplied so fast there that there was not only enough to supply the royal families, but much more.

Robert Holmes, a member of the Royal Horticultural Society in London, secured some of it to use in his own gardens, and presented roots to the King of England and it was grown in the royal gardens for his use.

Some of the new variety was sent back to New Zealand, its original home, and proved to be adapted to that climate. It also was the first rhubarb which could be successfully grown on the Cape of Good Hope at the southern tip of Africa. Thus it gained distribution in mild climates throughout the world.

The original supply of New Zealand rhubarb was secured through D. Hay & Son of Auckland, New Zealand. The first two shipments were lost, because the plants would not live during the long journey. However, the third shipment arrived safely in California and in it were about half a dozen of the small roots of this almost worthless food plant.

Mr. Burbank first grew these without crossing and increased their number to about one hundred. They produced seed in great quantities every year and this seed was planted and the seedlings carefully studied. Crosses were then made with other kinds of rhubarb, and astonishing indeed were the results.

A bed in which some of these seedlings were growing appeared rather ragged, because some of the plants were very small and some were very large. However, he wanted something unusual: he had to have a wide variety from which to select.

After the *Crimson Winter* variety was well distributed, he kept on making other hybrids and eventually had two more to introduce, one known as the *Burbank giant*, and the other known as the *New Giant Crimson Winter* Rhubarb. Both were of large size, and were very vigorous producers.

They both furnished crops the year around in California. However, the quality of the stalks was so good that, if they had produced only during the summer season, they still would have been worthy varieties. The stalks are never tough or stringy, and they have a pleasant taste when made into sauce or pies. The crimson color remains after the rhubarb is cooked and that, of course, adds to its palatability. When the roots are divided, a

large thrifty new plant has stalks ready to be harvested within twelve months.

Mr. Burbank continued to work with the rhubarb, hoping to get a hardy variety that could be grown in the northern sections. Even a hardy variety would not produce winter and summer, but he hoped to get one that would have the other desirable qualities of the new kind. Such a variety was not produced, but the rhubarb experiments afforded a good illustration of the world-wide scope of Mr. Burbank's activities in finding strange plants for crossing and then sending new varieties to every continent. Although he remained in Santa Rosa, his garden had plant guests from every country and his plant discoveries traveled around the globe.

It should be emphasized that one of the chief reasons why Mr. Burbank was able to get so many unexpected and unheard-of results was that he, unlike other experimenters, brought together plants from widely separated parts of the earth.

He continually received shipments of seeds, bulbs, and plants from all parts of the world. It is certain that there never were ten acres anywhere in the world on which grew so many different kinds of plants, or so many new plants resulting from the crossing of pollen, as grew at Santa Rosa and Sebastopol. Never did the plant improver

have a visitor, following the year 1888, who could recognize all of the plants growing on his grounds. There were usually more than a million plants growing on the ten acres. Some of these were very small; some of them occupied many square feet of ground. But he had the knack of making use of every inch of soil, and the minute a plant had served its usefulness, it was taken out and the ground used for something else.

It might be correctly said, therefore, that the few acres at Sebastopol and Santa Rosa made up a *world* laboratory for plant improvement.

HARDY BERRIES COME FROM SIBERIA

When Mr. Burbank started work with raspberries and blackberries in 1878, he had hardiness in mind as well as improved fruits. He decided to get some wild raspberries from the coldest place in the world—Siberia. These, he believed, would help make new bush fruits which would grow in any cold climate.

The plants from the far North produced berries which were worth almost nothing, it is true. The fruit was about the size of a pea, was a dark red color, and had large seeds. Furthermore, the flavor was not pleasing; but the plant could withstand cold winters.

Mr. Burbank liked the sturdiness of the stems and the

large size of the leaves. He felt that these were needed characters which would be transmitted to hybrids, and he knew that some new varieties might appear if enough seedlings were grown.

He crossed the Siberian berries with the California dewberry, which is a wild and hardy trailing blackberry found in the foothills of the state. The berries are usually produced in large numbers, they are black, of good size, and have a good flavor. They have not become popular as cultivated varieties, because of the fact that the staminate flowers grow on one bush and the pistillate flowers grow on another. For this reason, part of the bushes in a garden do not bear fruit, for staminate flowers produce only pollen, and all the berries grow on the bushes which bear pistillate flowers.

One variety of the California dewberry, called "Aughinbaugh," had been cultivated to some extent; and it was this one which Mr. Burbank selected for crossing with the wild Siberian plant.

He had no difficulty in making the combination of these wild strangers, for blackberries, raspberries, and dewberries can be crossed indiscriminately. He expected to get from this hybridization plants which would be of the widest diversity of character, and his expectations were realized. Nearly all of the hybrids were worthless.

Some of them did not have vitality enough to live. Some bore small berries, occasionally having only two or three seeds in each fruit.

There were a few, however—three or four—which grew with great vigor. One of these had fruit larger than either of its parents. The fruit looked somewhat like a blackberry in form, but was a dark red in color. When it was fully matured, it came away from the core as the raspberry does when picked. It was a hybrid with almost a perfect blend of the two wild parents, but much better than either. Named the *Primus berry*, it was really a raspberry.

The *Primus* was a good berry for home use, but was not good enough for commercial growing.

This was not the first raspberry which Mr. Burbank introduced. In 1893, he had sent forth a new variety which was called *Eureka*. It was larger than other raspberries, was a bright red color, had firm fruits, and was very productive. The bushes, incidentally, were almost free from thorns; yet as there were a few, Mr. Burbank did not call it a thornless raspberry.

Seedlings from the *Eureka* were grown and one was introduced under the name *Dictator*. This one was remarkable for its habit of yielding berries of enormous size. The berries were too soft for shipping, however, so the *Dictator* was introduced for home use only. A little

later, another raspberry was introduced under the name *Sugar*. It bore its fruits in October as the *Dictator* did.

This was quite an array of remarkable berries:

The *Primus*—raspberry not afraid of the cold.

The *Eureka*—raspberry without irritating thorns.

The *Dictator*—raspberry of enormous size.

The *Sugar*—raspberry for late fall use.

One year, Mr. Burbank traveled in Alberta, Canada, with the purpose of studying the natural hybrids of wild berries. He found many of them and concluded that Nature is continually making new species of berries by crossing the pollen. He made similar observations among strawberries, blueberries, and California lilacs.

This encouraged him to cross the dewberry with many varieties of raspberries and blackberries. Among the hybrids thus produced, there was one even more remarkable than the *Primus* berry. Originally named the *Humboldt*, it was later named by the seedsman to whom it was sold, *Phenomenal berry*.

This berry phenomenon resulted from experiments in which both the red and yellow raspberries were combined with the dewberry. The first generation of hybrids yielded nothing of importance, as usual. In the second generation, however, was one plant which was better than any Mr. Burbank had ever seen. Some of the berries were an inch and a half long and an inch in diameter.

They were a dark, rich crimson color, and they combined the qualities of the raspberry and blackberry in flavor. Here, again, was a blend of the characteristics of the two parents.

The *Phenomenal* berry is somewhat similar to a fruit called the *Loganberry* which was a natural hybrid created by Nature and discovered by Judge J. H. Logan of Santa Cruz, California. The *Phenomenal* berry, however, is larger, of better quality and color, and more productive than the Loganberry.

In ten years after its introduction, the *Phenomenal* berry was a popular variety among the growers of the Pacific Coast. It proved to be a commercial variety for it could be shipped to distant markets.

Other bush fruits introduced by Mr. Burbank are: *The Great American raspberry*, the *Himalaya berry*, the *Iceberg blackberry*, and the *Japanese Golden Mayberry*.

The bush fruits proved to be good material for the plant laboratory: and, as their names indicate, they were cosmopolitans representing strains from many lands.

Luther Burbank's experience with all kinds of plants showed him that foreign kinds are very useful in hybridizing experiments because they bring characteristics which have been developed under conditions quite different from those in America. Furthermore, when plants of widely separated sections are crossed, there is always

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great variation, with many surprises, in the offspring. As parent stock, those plants from the far corners of the earth were more useful in bringing about new and useful characters than locally grown plants.

So he welcomed plant immigrants of European, Asiatic and African origin; he worked with plums from France, peaches from China, gladioli from South Africa. His *Shasta* daisies had an ancestry part New England, part English, part German and part Japanese; his dahlias came from Mexico, and to help in his work with roses, he obtained some very interesting varieties from Chile. The importing of plants from foreign countries so fascinated him that he enjoyed growing them regardless of whether he made use of them or not. Even today, there are a number of strange plants growing on his grounds which are not likely to be found anywhere else in the United States.

From 1885 on, he continued to arrange with those going to foreign countries to send him what he wanted. He could thus devote all of his time to work, and not consume any of it in travel and exploration.

PLUMS COME FROM THREE CONTINENTS

At the time Luther Burbank began his work of seeking new kinds of plums, which was in 1885, America had very few good varieties. We were depending quite

largely upon the wild plums which grew here. But Mr. Burbank believed that it would be very valuable to get plums from other countries and combine the characteristics which they might have with those of the plums growing in America.

He had read that a plum with red flesh was to be found in the Province of Satsuma in southern Japan. Accordingly, he arranged with Isaac Bunting, an English bulb dealer who operated in Yokohama, Japan, to collect a number of plum seedlings.

The first shipment of plum seedlings from Mr. Bunting arrived in 1884 in very poor condition. Mr. Burbank therefore urged Mr. Bunting to send other seedlings, and on December 20, 1885, he received twelve plum trees from the Satsuma province which had been produced by Nature from the seeds of wild trees. Such trees are called "natural hybrids." No man had crossed the pollen to produce them; they were Nature's own creations.

Of course Mr. Burbank did not know whether their fruits would be of any value or not. But if they were not, he thought that they might serve as good parent stock to be used in crossing with plums from other countries. He had larger plum trees growing on his Sebastopol farm, and he grafted short pieces from the seedlings on the older trees in order to get the fruit sooner. And when he looked at the fruit of the twelve plum seedlings, he

was astonished because there were so many plums in this collection which appeared to be much better than those grown in the United States.

The first of these seedlings which proved good enough to be introduced bore fruit the year after it was grafted. The fruit was very large, heart-shaped, red with white bloom, and very good in flavor. Mr. Burbank showed it to all of the people who visited his place during the next two or three years. These visitors included men from the United States Department of Agriculture, and one of them, Professor H. E. Van Deman, urged Mr. Burbank to introduce this new plum. With this encouragement, he introduced it in 1889 as the *Burbank* plum.

Large size and its attractive color and taste made it popular at once. In a few years, as many as 125 carloads of the *Burbank* plum were shipped to eastern markets from California. This plum has proved to be of tremendous value in more places in the world than any other variety. The tree is able to adapt itself to more different kinds of weather and soil conditions than others have been able to do. It thrives through cold winters when the temperature goes as low as 30 degrees below zero. It also survives the hotter conditions experienced in South Africa.

One of the other twelve seedlings first bore its fruit in 1887. It was a plum with red skin and dark purplish-red

flesh, and it averaged about two inches in diameter. As the seedling came from the province of Satsuma, Japan, Mr. Burbank named it the *Satsuma*. It became popular in southern California and many of the eastern Gulf states, as well as in the southern hemisphere. However, it proved to be less adaptable to a wide variety of climates than the *Burbank* plum. It could not be grown very successfully, for example, in the colder places.

While Mr. Burbank introduced a few kinds of plums which were useful only where they were grown, his main effort was to provide horticulturists with varieties which could be shipped long distances. He believed that California was destined to produce fruit which could be shipped to New York successfully.

So it was necessary to study market demands; to study shipping conditions; to exhibit his fruit to growers, scientists, and government officials; and to learn in every way possible all that was necessary to know in order to judge the probable popularity and usefulness of the new varieties.

It would be almost truthful to say that it was Mr. Burbank's work which started the commercial shipping of plums. Previously, the plum had been quite largely a home fruit; a family which had no plum trees usually went without plums. But Mr. Burbank's work developed varieties which were such good shippers that hundreds of

MAGIC GOES AROUND THE WORLD

carloads were soon being carried entirely across this country, making the three-thousand-mile journey from west to east as successfully as he himself had once made it from east to west.

About three years after the introduction of several of his large shipping plums, a third of all the plums shipped from California were his new varieties. At Santa Rosa and Sebastopol, plum immigrants from three continents had been successfully Americanized, and many of them were on the way to international success.

19. THE BEES AND THE HUMMING- BIRDS HELPED



UTHER BURBANK MADE USE OF the fertilizing habits of both the bees and hummingbirds. In his gladioli experiments, he planted the two parents to be crossed in adjoining rows, knowing that the bees and hummingbirds would be likely to go from one row to the other, and thus carry the pollen in the way he desired it.

The hummingbirds were particularly fond of the gladioli, and did a great deal of the pollinizing for him. It made very little difference which blossom furnished the pollen because, after all, Mr. Burbank was not trying to disclose Nature's rules: he was trying to produce new

THE BEES AND THE HUMMINGBIRDS HELPED flowers. And by making use of the hummingbirds and the bees, he produced new flowers much more rapidly.

In the production of the world's earliest cherry, Luther Burbank again enlisted the aid of the bees in carrying the pollen. If he had undertaken to carry the pollen from one parent cherry tree to another, he would have had to content himself with only a few seeds each year. But by getting the bees to do the work for him, he was able to get thousands of seeds from one tree which represented a cross between that tree and another selected variety.

In order to get the bees to cross-pollinize two varieties, he broke off branches from one tree, after it was in full bloom, and placed them upon the branches of the other. When bees are working on one kind of flower, they do not visit other types. When they are taking the nectar of the cherry blossoms, they visit no other fruit tree. Consequently, he was sure that the bees would take the pollen from the broken branch and place it on the pistils of the flowers in the tree on which the branch was placed. In this way, he got the bees to make the cross, and bees always do a thorough job.

The parent cherries used in these crosses were popularly known as the Early Purple Guigne and the Black Tartarian. As time went on Mr. Burbank secured cherries from Russia, from France, and from the eastern United

States. Pollen from the foreign varieties was transferred to the hybrids, and eventually, several entirely new cherries were produced which were better than any of the parents. Several of them bore their fruits very much earlier, but the early ones were inferior in other respects; and early bearing alone was not enough to justify the selection of the new individual.

However, these early-bearing kinds were used as parents for further crossing, and eventually, with the aid of the bees, he developed the *Burbank* cherry. It ripened several weeks earlier than any other fruit. It was large in size, attractive in color, savory in flavor. And, best of all, it withstood shipment across the continent. The trees were hardy, had abundant foliage to protect the fruit from the sun, and it was a prolific bearer.

Before introducing the *Burbank* cherry to the general public in 1911, Mr. Burbank sent sample shipments to the eastern states. In 1908, a ten-pound box sold at public auction for \$15.00. Later on, an entire carload was sold for \$7.50 per ten-pound box. In 1909, a ten-pound box was sold in Philadelphia for \$31, or \$3.10 a pound!

In his 1911 catalog, entitled "Twentieth Century Fruits," Mr. Burbank described the *Burbank* cherry as follows:

"The earliest of all large cherries, the largest of all early cherries, and not only the best of all early cherries,

THE BEES AND THE HUMMINGBIRDS HELPED but unsurpassed by any cherry of any season. The trees are model in form, vigor, and never failing productiveness. The foliage, which is of unusual size, is so placed that the fruit is fully protected from birds and from cracking caused by late spring rains."

The *Black giant* and the *Honey Heart* cherries were introduced later and may now be purchased from nurserymen, but the *Burbank* was the one which brought more per pound than is paid for the most expensive candy.

Why was the high price paid? In the first place, there were only a few available. In the second place, the cherries came very early in the season. Thus, the dealer knew there would be no competition for several weeks. Furthermore, the cherries were so large and beautiful in color, and had such a delicious flavor that he knew he would have no difficulty in finding retail buyers who would pay a high price. This emphasizes the importance of Mr. Burbank's idea that an extra early cherry would have a better demand than others, and illustrates his grasp of market demands in a far-away city.

As proof of the shipping ability, he sent a box of the *Burbank* cherries to New York and had it shipped back to California. When it arrived after making the round trip, the fruit was still in perfect condition. None of the cherries was too soft. None of them was damaged in any way.

This careful attention to production, all the way from pollen transfer to packaging, shipment and sale of the fruit in distant markets, distinguished Mr. Burbank's work from that of the botanist concerned only with tracing plant pedigrees.

Interested persons frequently ask: "Who carried on Mr. Burbank's work after his death?" The answer is that, as yet, no one has attempted to carry on the work in which Mr. Burbank was so successful, and for several very good reasons.

In the first place, Mr. Burbank was working on so many experiments at the time of his death that it would have been almost impossible for anyone to know what he had in mind in each case. When I asked him one day how many experiments he had under way, he said, "I always have at least three thousand."

There was no other person at any time in his life who knew all that he was striving for. His workmen knew how to dig, plant, rake, and hoe, but they had no idea whatever of the value of the plants with which they were working. No one helped with his plant-pollenizing except the bees and hummingbirds. Sole responsibility for planning, selecting and making decisions was his.

There was no kind of labor on his place in which he did not himself engage. He gave very few orders that

THE BEES AND THE HUMMINGBIRDS HELPED
were not accompanied by a demonstration of how to do the work, and he could do a better job than any of his workmen. But he did not expect everyone to be just like he was, for he knew that other people have different experiences and different thoughts.

Some idea of his intense interest in his work and of his ability to handle men may be gained from two incidents:

Among the millions of plants representing three thousand experiments at Santa Rosa, Mr. Burbank once had a huge plant of Swiss chard. One morning he came into my office more excited than I had ever seen him.

"Did you cut down that Swiss chard of mine?" he demanded.

"Mr. Burbank, I would never cut a plant of any kind in your garden," I assured him. "I have never picked a flower or fruit unless you told me to. Certainly, I did not cut down your Swiss chard."

"Well," he said, "somebody did. Beaty, I would rather have my right arm cut off than to lose one of the plants with which I am working. That Swiss chard was the result of many years of work. But I know you didn't do it. Forgive me for accusing you. It is such a loss that I just couldn't restrain myself."

He and I were walking through his greenhouse one

day and there we saw a Mexican whose name was Joe. Joe was pounding a bag full of seed pods. The process he used for threshing the seeds was to place the pods in a bag and then pound the bag with a stick.

Joe was moving the stick very slowly and he wasn't getting along with his job very fast. As we approached him, Mr. Burbank said, "Pound 'em like the devil, Joe. Pound 'em like the devil!"

Joe moved faster. When we got outside where Joe couldn't hear us, Mr. Burbank said, "That's the only language Joe understands."

Another difference between Mr. Burbank and the orthodox researchers was his refusal to specialize. Some plant experts have specialized on apples, others on dahlias; but Mr. Burbank never limited his interest to one field. He always worked with dozens of kinds of plants. No one else, as yet, has had the broad viewpoint which enabled him to carry on many simultaneous projects, while keeping all the essential details in mind.

It is not at all unlikely that someone sometime in the future may work on as broad a scale as Luther Burbank did. There is no reason at all why it should not be done, no reason why as good results should not be expected. Everyone else, however, up to now, has worked on a much smaller scale.

Although no one—scientist or layman—was able to

THE BEES AND THE HUMMINGBIRDS HELPED carry on the work in which Mr. Burbank excelled, it is pleasing to realize that there are thousands throughout the world who have been influenced by his success and made use of his published records. Perhaps if we added together the plant creations of all of these people, we could truthfully say that Mr. Burbank's work is being carried on not by one individual, but by a large group of Nature enthusiasts.

Certainly, his experience has had a beneficial effect upon the world, not only because of what he gave the world in new plant creations, but because of what he taught others who now believe that it is our destiny to help Nature improve the fruitfulness of this planet.

Even after he was a world-famous man, Luther Burbank was timid and shy. Once he was asked to speak to the children of a near-by school on his birthday. "You go in my place," he urged me. "I just can't think what to say. But you tell the boys and girls I love them. Tell them that I know they will grow into good men and women. Tell them this is a beautiful world full of wonders. Tell them to look for interesting things and they'll never have a dull moment in their lives. Tell them to learn how to use what they find. Tell them to have confidence and faith. Who knows—one of them may do all that I have done, and more."

Some of Luther Burbank's Most Important Plant Creations

Apples

Goldridge
Winterstein

Artichoke

Santa Rosa

Asparagus

Quality

Berries

Balloon Berry
Dictator Raspberry
Eureka Raspberry
Great American Raspberry
Himalaya
Iceberg Blackberry
Japanese Golden Mayberry
New type Balloon Berry
Patagonia Strawberry
Phenomenal
Primus
Rubus Capensis
Sugar Raspberry
Sunberry or Wonderberry

Cacti

Actual
Arbiter
Banana
Bijou
Cereus Pitajya
Chico

Columbia

Competent
Eldorado

Elegant

Fresno

Gravity

Hemet

Market

Melrose

Model

Monter ,

Myers

Niagara

Opaline

Pyramid

Quillota

Robusta

Royal

Santa Rosa

Signal

Solano

Sonoma

Special

Sugar

Superb

Titania

Vertex

Zalisco

Cherry

Abundance
Black Giant
Burbank
Honey Heart

Corn

Rainbow

Flowers

Amaryllis

Martinique

"Multiplier"

Callas

Dwarf Ever-bloom-
ing

Fragrance

Giant

"One Best"

Snowflake

Canna

Burbank

Tarrytown

Dahlias

Burbank

David Burpee

Fragrant

Giant Yellow

Golden West

Lemon Yellow

"Marigold"

Mountain

Sebastopol

"Unique Salmon"

Daisies, Shasta

Alaska

Bowman

California

Westralia

LUTHER BURBANK

Flowers—(Continued)

Dicentra,
 "Modoc Pearl"
 Eschscholzia
 Crimson
 Fireflame
 Gladiolus
 California
 Cisco
 Conquest
 Dazzling
 Elegance
 Esthetic
 Gigantic
 Graceful
 Harmonious
 Igo
 Mariposa
 Modesto
 Mono
 Opaline
 Pinnacle
 Pohono
 Radio
 Santa Rosa
 Shasta
 Signal
 Symmetry
 Yolo
 Heuchera cristata (Im-
 proved)
 Improved Alstroemeria
 chilensis
 Improved Chlidanthus
 fragrans
 Larkspur (Burbank
 Hybrids)
 Lily
 Fragrans
 Glow
 Pentstemon (New
 BrilliantCrimson)
 Poppies
 Burbank

Celeste
 Celestial Strain
 Goldleaf
 Improved Shirley
 Shirley (Santa Rosa
 Strain)
 Silver Lining
 Evening Primrose
 America
 Roses
 All Blossoms
 Burbank
 Copper Climber
 Coquito
 Corona
 Golden Sunset
 Little Hermosa
 Peachblow
 Pet
 Santa Rosa
 Snowwhite Climber
 Verbenas
 Elegance
 Mayflower
Grape
 Montecito
Grasses
 Lippia Repens, Dixie
 New Dwarf Pampas
Ground Nut
 Giant
Nectarines
 Blood
 Flaming Gold
Nuts
 Hale Chestnut
 McFarland Chestnut
 Palatine Almond
 Paradox Walnut
 Royal Walnut
 Santa Rosa Walnut
Peaches
 Burbank's giant
 July Elberta

July gold
 Leader
 National
 Opulent
 Pear
 Test
Plums
 Abundance
 America
 Apple
 Ballena
 Bartlett
 Beauty
 Burbank
 Chabot
 Chalco
 Choice
 Climax
 Combination
 Compass
 Delaware
 Delicious
 Doris
 Duarte
 Elephant Heart
 Epoch
 First
 Flaming Delicious
 Formosa
 Gaviota
 Geewhiz
 Glow
 Gold
 Great Yellow
 Hale
 Hermosillo
 Honeymoon
 Juicy
 June Blood
 June Redskin
 Madera
 Mammoth Cardinal
 Maynard
 Miracle

MOST IMPORTANT PLANT CREATIONS

Plums—(Continued)

Monster
 Nixie
 October Purple
 Othello
 Pasha
 Prize
 Purple Flame
 Red Ace
 Rubio
 Santa Rosa
 Satsuma
 Scarlet Flame (a red-
 leafed decorative
 plum)
 Shipper
 Shiro
 Sultan
 Vesta
 Vesuvius
 Victory
 Wickson

Plumcots

Apex Corona Orange
 Corona
 Orange
 Purple

Rutland
 Triumph

Potato

Burbank

Prunes

Conquest
 Giant
 Grand Prize Purple
 Morganhill
 Pearl
 Splendor
 Standard
 Sugar

Quinces

Childs
 Pineapple
 Van Deman

Rhubarb

Crimson Winter
 Giant Pink
 Improved Giant Crim-
 son Winter

Rose Flowering Peach Trees

Orchid
 Santa Rosa

Squashes

Begonia-leaved
 Patagonia

Tomato

Burbank Preserving

Vines

Clematis
 Ostrich Plume
 Snowdrift
 Waverly
 Ipomea, "Imperial
 Carmen"
 Scyphanthus elegans
 S. C. alba

Solanum

Gaynum
 Giant White

Miscellaneous

Asclepias, New
 Chilian
 Chilian Tomatillo
 Chilian Water Cress
 Chives, New Pink
 Myrtle, New White
 Variegated
 Phytolacca, Chilian sp.

Some of the Plants with Which Mr. Burbank Worked

Abutilon	Camellia	Eucalyptus
Acacia	Canna	Everlasting flower
Acanthus	Carnation	
Alfalfa	Carrot	Feijoa
Alligator pear	Cedar	Fir
Almond	Celery	Flax
Alstromera	Cereus	Forget-me-not
Amaryllis	Champion flower	Fuchsia
Ampelopsis	Chard	
Apple apricot	Cherry	Garlic
Artichoke	Chestnut	Geranium
Asparagus	Chives	Gladiolus
Aster	Clematis	Goldenrod
	Clover cockscomb	Goumi berry
Balloon berry	Coreopsis	Gourd
Balsam fir	Corn	Grape
Barberry	Cotton	Grasses (many kinds)
Barley	Cress	Guava
Bean	Crinum	
Beet	Cucumber	Hawthorn
Birch	Currant	Hazelnut
Blackberry	Cypress	Hemp
Blue flag		Hickory
Brodiaea	Daffodil	Hops
Buffalo berry	Dahlia	Horse chestnut
Buttercup	Daisy	Hydrangea
Butternut	Dandelion	
	Devil's claw	Iceplant
Cactus		Iris
Calceolaria		
Calendula	Eggplant	Judas tree
Calla	Elaeagnus	Juneberry
Callistemon	Elder	Jute
Camassia	Elm	

PLANTS WITH WHICH MR. BURBANK WORKED

Kale	Palms	Rye
Larkspur	Pampas grass	Scilla
Laurel	Pansy	Scotch broom
Lemon	Parrotbill flower	Sensitive plant
Lettuce	Parsnip	Sisyrinchium
Lilac	Passion flower	Snowball
Lily	Peach	Snow-on-the-mountain
Lippia	Peanut	Solanum
Live oak	Pear	Sorghum cane
Loquat	Peas	Spanish broom
	Pentstemon	Squash
Magnolia	Pepper	Squaw berry
Maple	Persimmon	Starflower
Marigold	Petunia	Strawberry
Martynia	Phenomenal berry	Sugarcane
Mayberry	Pine	Sumac
Medlar	Pink	Sunberry
Milkweed	Pitcher plant	Sunflower
Millet	Plum	Sweet pea
Monkey puzzle tree	Plumcot	
Morning glory	Pomegranate	Tecoma
Mountain ash	Poppy	Thistle
Mustard	Potato	Tigridia
Myrtle	Primrose	Timothy
	Primus berry	Tomato
	Prune	Tritoma
Nasturtium		Tulip
Nectarine	Quince	
Nutmeg		Verbena
		Vetch
Oats	Radish	Violet
Olive	Raspberry	Virginia creeper
Onion	Redwood tree	
Ophiopogon	Rhubarb	Walnut
Orange	Rice	Watsonia
Orchid	Rose	Wheat

Some Important Dates in Luther Burbank's Career

- 1874—Began work with black walnuts.
- 1875—Luther Burbank left Massachusetts for California.
- 1877—First fruit trees sold from his Santa Rosa nursery.
- 1877—Income from the sale of nursery stock was \$15.20.
- 1878—Began work with gooseberry, blackberry, raspberry, juneberry, strawberry, currant.
- 1878—Work started with raspberries and blackberries.
- 1878—Income from nursery \$84.
- 1879—Began work with prunes.
- 1879—Income from nursery \$353.28.
- 1880—Work for a thornless blackberry begun.
- 1880—Income from nursery \$702.
- 1881—Produced 20,000 prune trees in one year.
- 1881—Income from nursery \$1,112.69.
- 1882—Purchased four acres in Santa Rosa for his experimental garden.
- 1882—Experiments with the gladiolus began
- 1884—Chestnuts received from Japan.
- 1884—20 pounds of pear seeds imported from Japan.
- 1884—Began work with pear, quince, peach, chestnut, loquat, persimmon.
- 1884—Made crosses of Oriental quinces on American varieties.
- 1885—Began life work of devoting all his time to creating new plants.
- 1885—Began work with plums, grapes, verbena.
- 1886—Began work with apples, almonds.
- 1887—Began work with tomato.
- 1887—Satsuma plum fruit first seen.

IMPORTANT DATES IN BURBANK'S CAREER

- 1888—So many strange plants grew in Burbank's garden that no one scientist could recognize them all.
- 1889—Burbank plum introduced.
- 1890—Seeds of the Sand Pear imported from China.
- 1891—Wilder medal awarded for Burbank's Van Deman quince.
- 1893—Eureka raspberry introduced.
- 1895—Crosses first made between peaches and nectarines.
- 1901—Gold medal awarded for the plumcot by the Pan-American Exposition, at Buffalo, N.Y.
- 1903—First stoneless plum sold to Oregon Nursery Co.
- 1904—Gold medal awarded the Burbank Rose by the St. Louis International Exposition.
- 1905—Introduced the sunberry, the name of which was changed to wonderberry by the seedsman.
- 1905—Order to make a new variety of canning peas received.
- 1908—Burbank cherry tested for shipping ability.
- 1909—Catalog issued offering 136 new varieties of Amaryllis.
- 1909—Burbank cherries sold for 31 cents per pound.
- 1910—Burbank's pineapple quince is the first quince to be shipped from California to New York.
- 1911—Thornless blackberry produced.
- 1911—Burbank introduced his first stoneless prune, the Conquest.
- 1911—Test pear introduced.
- 1911—Burbank cherry introduced.
- 1912—New peas made to order were delivered to the Empson Canning Co.

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(Continued from front flap)

Fantastic stories were told of Burbank and his plant farm; nearby neighbors at Santa Rosa were as curious as the scientific observers and newspaper reporters who came from far away. Burbank's shyness, independence of thought, and indifference to public comment, helped the legends about him grow. Many of the stories which flourished were exaggerated, but none was more fascinating than the true story of tireless experiment, frequent failure and tremendous success—here told by a writer and naturalist who had the good fortune to watch the master grower at work.



About the Author:

JOHN Y. BEATY, like Luther Burbank, began to be interested in plants and animals when he was a small boy. After school and college in his native Iowa, he edited a farm paper and taught agricultural journalism in the University of Wisconsin, then went to California to assist in the preparation of Luther Burbank's autobiography. This work, which gave him the status of friendly observer at the Burbank farms during the days of important experiment, furnished the sound factual foundation for the present book.

Busy years as an editor, magazine writer, and lecturer on natural history followed, and before writing LUTHER BURBANK: Plant Magician, Mr. Beaty found time to publish a great many books, some of them listed on this jacket. He now combines country life and city duties by living on a rural delivery route within commuting distance of Chicago.